Appendix C-1

Plant Community Descriptions, Tables, and Figures

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Plant Community Descriptions (Alternative 1)

Riparian Communities

- Southern Riparian Woodland (SRW, CLORF, SWRF, CWRF) – a medium-density, broad-leafed riparian woodland community dominated by small trees or shrubs, with scattered taller riparian tree species. Characteristic species within southern riparian woodland include California sycamore (*Platanus racemosa*), willows (*Salix* spp.), Fremont's cottonwood (*Populus fremontii*), and Mexican elderberry (*Sambucus nigra*).
- Southern Riparian Scrub (SWS, MFS, SRS) – a dense, winter-deciduous riparian scrub community. In the project areas, it is typically dominated by mulefat (*Bacharris glutinosa*) and arroyo willow and may include several other willow species (e.g., black willow and western sand bar willow [*Salix exigua*]) and stinging nettle (*Urtica holosericea*). This habitat type is considered an early successional stage that will grow to riparian woodland, eventually without disturbance.
- Open Water/Open Gravel (OW, FLO) – encompass non-vegetated or very sparsely vegetated areas. Included in this habitat type are sand and gravel washes, mud banks, and open water. Vegetation may occur in these floodplains or channels but is usually less than 10% total cover.
- Freshwater Marsh (FWM, CVFM) – wetlands that are permanently flooded by standing freshwater lacking a significant current. Characteristic species include woolly sedge (*Carex pellita*), cattail (*Typha* spp.), and southern mudwort (*Limosella aquatica*).
- Mixed Woodland (SRF) – characterized by riparian woodlands containing less than 70% willows and a low occurrence of exotic vegetation. Plant species included in this community are California sycamore, willows, coast live oak (*Quercus agrifolia*), and Mexican elderberry.
- Sycamore Grassland (SG) – grasslands containing open, winter-deciduous broad-leaved riparian woodland overwhelmingly dominated by well-spaced California sycamore. The understory is usually dominated by non-native grasses (*Bromus* spp., *Vulpia* spp., etc.).
- Grass-forb Mix (NNR) – includes exotic species such as mustard (*Brassica* spp.), sweet fennel (*Foeniculum vlugare*), non-native grasses, and goldenbush (*Isocoma menziesii*).
- Mixed Willow-Exotic/ Exotic-Other (NNR, ARU) – characterized as containing less than 70% willows, with a large percentage of exotic plants including giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), common reed (*Phragmites australis*), and pampas grass (*Cortaderia* spp.).

Upland Scrub Communities

- Diegan Coastal Sage (DCSS, CSSB) – consists of sparsely to densely spaced, low- growing, drought-deciduous shrubs. Plant species characteristic of Diegan Coastal Sage Scrub include coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Salvia mellifera*), white sage (*Salvia apiana*), and bush monkey-flower (*Mimulus aurantiacus*).

Upland Grassland/ Herbaceous Communities

- Non-native Grassland (NNG, NNGB) – a community dominated by non-native annual grasses and weedy herbaceous species. Dominant exotic species include ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), wild oats (*Avena* spp.), wild barley (*Hordeum* spp.), Italian ryegrass (*Festuca perennis*), filaree (*Erodium* spp.), and soft chess brome (*Bromus hordeaceus*).
- Non-native Vegetation (NNGB) – characterized by non-native, invasive broadleaf species. Within the project area this community is dominated by sweet fennel, non-native thistle species (*Carduus pycnocephalus*, *Silybum marianum*, *Centaurea melitensis*), and mustard species (*Brassica nigra*, *Hirschfeldia incana*).
- Purple Needlegrass (VNG) – dominated by the perennial, bunch-forming purple needlegrass (*Stipa pulchra*). This community usually occurs on fine-textured (often clay) soils. Native and introduced annual grasses usually occur between the perennials, often exceeding the bunchgrasses in cover.

Upland Woodland Communities

- Eucalyptus Woodland (EUC) – non-native woodland dominated by large naturalized blue and/or red gum trees (*Eucalyptus* spp.).
- Coast Live Oak Woodland (CLO) – dominated by coast live oak that occurs on shaded slopes, bottomlands, and valleys, but not particularly in riparian corridors.

Disturbed/Developed

- Disturbed Habitat and Developed (DIST, DEV) – is where past or present physical disturbance is prevalent such that an area is no longer recognizable as a native or naturalized vegetation association; in addition to areas that do not support native vegetation and are characterized by permanent or semi-permanent structures.

Plant Community Descriptions (Alternative 2)

Riparian Communities

- Southern Riparian Woodland (SRW) (62500) is a medium-density riparian woodland community dominated by small trees or shrubs, with scattered taller riparian tree species. Characteristic species within SRW include California sycamore (*Platanus racemosa*), willows (*Salix* spp.), and elderberry (*Sambucus nigra* ssp. *caerulea*).
- Southern Coast Live Oak Riparian Forest (CLORF) (61310) is a dense riparian forest dominated by coast live oak with a closed, or nearly-closed, canopy. Characteristic species include mugwort, toyon (*Heteromeles arbutifolia*), California wild rose (*Rosa californica*), California blackberry, poison oak, and blue elderberry.
- Southern Arroyo Willow Riparian Forest (SWRF) (61320) is a winter-deciduous riparian forest dominated by arroyo willow (*Salix lasiolepis*) and having closed, or nearly-closed canopies. Characteristic species include mugwort, mule-fat (*Baccharis salicifolia*), California sycamore, cottonwoods (*Populus* spp.), black willow (*Salix gooddingii*), and stinging nettle (*Urtica dioica*).
- Southern Cottonwood/Willow Riparian Forest (CWRF) (61330) is a tall, open, broad-leaved winter-deciduous riparian forest that is dominated by willows (*Salix* spp.), western cottonwood (*Populus fremontii*), and/or black cottonwood (*Populus trichocarpa*).
- Southern Willow Scrub (SWS) (63320) is a dense, winter-deciduous riparian scrub community. In the project areas, it is typically dominated by arroyo willow and may include several other willow species (e.g., black willow and western sand bar willow [*Salix exigua*]) and mule-fat.
- Southern Riparian Forest (SRF) (61300) is a riparian community with mixed tree canopy, but no apparent dominant species. Typical trees may include coast live oak (*Quercus agrifolia*), willows (*Salix* spp.), western sycamore (*Platanus racemosa*), and/or western cottonwood.
- Southern Riparian Scrub (SRS) (63300) is a shrubby riparian thicket dominated by willows and coyote brush.
- Sycamore Grassland (SG) (62100) is open to moderately closed, winter-deciduous broad-leaved riparian woodland overwhelmingly dominated by well-spaced sycamore (*Platanus racemosa*), with blue elderberry widely spaced in the subcanopy. The understory is usually dominated by non-native grasses.
- Mule-fat Scrub (MFS) (63310) is a riparian scrub community dominated by mule-fat and often represents an early seral stage in the establishment of willow- or sycamore-dominated riparian forests. Other species that are characteristic of this vegetation community include arroyo willow and poison hemlock.
- Non-native Riparian (NNR) (65000) is dominated by non-native species, including giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), common reed (*Phragmites australis*), and pampas grass (*Cortaderia* spp.). NNR is found in a variety of wetland habitats, often where disturbance has occurred.
- Arundo-dominated Riparian (ARU) (65100) describes riparian thickets that are almost exclusively dominated by giant reed (*Arundo donax*).

Upland Scrub Communities

- Diegan Coastal Sage Scrub (DCSS) (32510) consists of sparsely to densely spaced, lowgrowing, drought-deciduous shrubs. Plant species characteristic of DCSS include coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sag (*Salvia mellifera*), white sage (*Salvia apiana*), and bush monkey-flower (*Mimulus aurantiacus*).
- Diegan Coastal Sage Scrub: Baccharis-Dominated (CSSB) (32530) is similar to DCSS but dominated by coyote brush (*Baccharis pilularis*). This community is often found within other forms of DCSS on mesic slopes and adjacent to drainages, particularly on previously disturbed sites. Other characteristic species include California sagebrush, California buckwheat, and coastal goldenbush (*Isocoma menziesii*).
- Coastal Sage-Chaparral Scrub (CSS-CHAP) (37G00) is a mixed community of both low, soft leaved coastal sage species and taller leathery leaved shrubs. The dominant taller evergreen species within the project area include lemonade berry (*Rhus integrifolia*), toyon (*Heteromeles arbutifolia*) and laurel sumac.
- Southern Mixed Chaparral (SMC) (37130) is a sclerophyll shrub dominated community often with patches of bare soil or forming a mosaic with scrub communities. This community is typically found on dry, rocky slopes with little soil and moderate temperatures. In the project area, SMC is typically dominated by chamise (*Adenostema fasciculatum*), with laurel sumac (*Malosma laurina*) and scrub oak (*Quercus berberidifolia*) as common components.

Upland Grassland/ Herbaceous Communities

- Valley Needlegrass Grassland (VNG) (42110) is dominated by the perennial, bunch-forming purple needlegrass (*Stipa pulchra*). This community usually occurs on fine-textured (often clay) soils. Native and introduced annual grasses usually occur between the perennials, often exceeding the bunchgrasses in cover.
- Non-native Grassland (NNG) (42200) is dominated by non-native annual grasses and weedy herbaceous species. Dominant exotic species include ripgut brome (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), wild oats (*Avena* spp.), wild barley (*Hordeum* spp.), Italian ryegrass (*Festuca perennis*), filaree (*Erodium* spp.), and soft chess brome (*Bromus hordeaceus*).
- Non-native Grassland: Broadleaf-dominated (NNGB) (42210) is dominated by non-native, invasive broadleaf species. NNGB is generally found in disturbed areas. Within the project area this community is dominated by sweet fennel (*Foeniculum vulgare*), non-native thistle species (*Carduus pycnocephalus*, *Silybum marianum*, *Centaurea melitensis*), and mustard species (*Brassica nigra, Hirschfeldia incana*).

Bottomland Communities

- Coastal and Valley Freshwater Marsh (CVFM) is typically dominated by perennial, emergent monocots (e.g., rushes [*Juncus* spp.], sedges [*Carex* spp.], cattails [*Typha* spp.]), and often consists of uniform stands with closed canopies. This community occurs in wetlands that are permanently to semi-permanently flooded by standing freshwater lacking a significant current. Prolonged saturation of such areas permits the accumulation of deep, peaty soils.

- Freshwater Marsh (FWM) (52400) typically occurs on MCB Camp Pendleton in coastal floodplains and valleys; dominated by sedges, (*Carex* spp.), bulrushes (*Scripus* spp.), and cattails (*Typha* spp.).
- Non-vegetated Floodplain or Channel (FLO) (64200) includes the sandy, gravelly, or rocky fringe of waterways or flood channels. Vegetation may occur in these floodplains or channels but is usually less than 10% total cover.
- Open Water (OW) (13140) areas include the freshwater waters and substrates of mostly unvegetated bodies of water. This habitat type includes ponds, lakes, creeks, streams, and rivers.

Upland Woodland Communities

- Eucalyptus Woodland (EUC) (11100) is a type of non-native woodland dominated by large naturalized blue and/or red gum trees (*Eucalyptus* spp.).
- Coast Live Oak Woodland (CLO) (71160) is a woodland dominated by coast live oak that occurs on shaded slopes, bottomlands, and valleys, but not particularly in riparian corridors. Holland/Oberbauer identifies variations for open canopy (71161) and dense canopy (71162).

Disturbed/Developed

- Agriculture (AGR) (18300) describes areas used as agricultural fields in the past and/or present.
- Disturbed Habitat (DIST) (11000) is where past or present physical disturbance is prevalent such that an area is no longer recognizable as a native or naturalized vegetation association.
- Urban/Developed (DEV) (12000) areas do not support native vegetation and are characterized by permanent or semi-permanent structures.

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Table C-1. Potential Permanent Impacts to Plant Communities within the Santa Margarita River Conjunctive Use Project Area for the Alternative 1

Plant Community Type	Waters of the U.S. (No/ Yes)	Permanent Impact Acreages within the Project Area							
		Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Bi-directional Pipeline and Booster Pump Stations			FPUD WTP	Project Total
		MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	Non-DOD	
Riparian (as defined by the Riparian BO)									
Southern Riparian Woodland	No	-	-	-	-	-	-	-	0.00
	Yes	-	0.02	-	-	-	-	-	0.02
Southern Riparian Scrub	No	0.15	-	0.81	-	-	-	-	0.96
	Yes	0.35	0.53	-	-	-	-	-	0.88
Open Water/Open Gravel	No	-	-	-	-	-	-	-	0.00
	Yes	0.35	1.26	-	-	-	-	-	1.61
Freshwater Marsh	No	-	-	-	-	-	-	-	0.00
	Yes	-	-	-	-	-	-	-	0.00
Mixed Woodland	No	0.08	-	0.07	-	-	-	-	0.15
	Yes	0.12	0.07	-	-	-	-	-	0.19
Sycamore Grassland	No	-	-	-	-	-	-	-	0.00
	Yes	-	-	-	-	-	-	-	0.00
Grass-forb Mix	No	0.13	-	0.83	-	-	-	-	0.96
	Yes	0.15	0.27	-	-	-	-	-	0.42
Mixed-willow Exotic/ Exotic-Other	No	-	-	-	-	-	-	-	0.00
	Yes	-	0.01	-	-	-	-	-	0.01
Subtotal		***1.33***	***2.16***	***1.71***	***0.00***	***0.00***	***0.00***	***0.00***	***5.20***

Plant Community Type	Waters of the U.S. (No/ Yes)	Permanent Impact Acreages within the Project Area							
		Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Bi-directional Pipeline and Booster Pump Stations			FPUD WTP	Project Total
		MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	Non-DOD	
Upland Scrub									
Diegan Coastal Sage Scrub	N/A	0.23	0.03	-	0.17	-	-	-	0.43
	Subtotal	***0.23***	***0.03***	***0.00***	***0.17***	***0.00***	***0.00***	***0.00***	***0.43***
Upland Grassland/Herb									
Non-native Grassland	N/A	-	-	-	-	-	-	-	***0.00***
Non-native Vegetation	N/A	-	-	-	-	-	-	-	***0.00***
Purple Needlegrass	N/A	-	-	-	-	-	-	-	***0.00***
	Subtotal	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***
Upland Woodland									
Eucalyptus Woodland	N/A	-	0.05	-	-	-	-	-	***0.05***
Coast Live Oak Woodland	N/A	-	-	-	-	-	-	-	***0.00***
	Subtotal	***0.00***	***0.05***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.05***
Disturbed/Developed									
Disturbed and Developed Habitat	N/A	0.04	0.06	0.23	0.08	0.00	0.21	5.09	5.71
	Subtotal	***0.04***	***0.06***	***0.23***	***0.08***	***0.00***	***0.21***	***5.09***	***5.71***
Total		**1.60**	**2.29**	**1.94**	**0.25**	**0.00**	**0.21**	**5.09**	**11.38**

FPUD = Fallbrook Public Utility District; WTP = Water Treatment Plant; MCB = Marine Corps Base; DET Fallbrook = Naval Weapons Station, Detachment Fallbrook; DOD = Department of Defense.

Table C-2. Potential Temporary Impacts to Plant Communities within the Santa Margarita River Conjunctive Use Project Area for Alternative 1

Plant Community Type	Temporary Impact Acreages within the Project Area								
	Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Temporary Construction Lay-down Area	Bi-directional Pipeline[2] and Booster Pump Stations			FPUD WTP	Project Total
	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	Non-DOD	
Riparian (as defined by the Riparian BO) [1]									
Southern Riparian Woodland	-	0.24	2.24	-	-	0.11	-	-	2.60
Southern Riparian Scrub	0.41	0.20	4.37	0.01	0.60	0.50	-	-	6.09
Open Water/Open Gravel	0.31	0.23	0.75	-	-	-	-	-	1.29
Freshwater Marsh	-	-	-	-	-	-	-	-	0.00
Mixed Woodland	0.22	2.84	0.49	-	0.15	-	-	-	3.70
Sycamore Grassland	-	-	-	-	-	-	-	-	0.00
Grass-forb Mix	0.24	4.57	3.40	-	-	-	-	-	8.21
Mixed-willow Exotic/ Exotic-Other	-	0.22	0.23	-	-	-	-	-	0.45
Subtotal	***1.18***	***8.30***	***11.49***	***0.01***	***0.75***	***0.61***	***0.00***	***0.00***	***22.34***
Upland Scrub									
Diegan Coastal Sage Scrub	0.20	1.47	0.22	-	7.27	16.16	-	-	25.32
Subtotal	***0.20***	***1.47***	***0.22***	***0.00***	***7.27***	***16.16***	***0.00***	***0.00***	***25.32***
Upland Grassland/Herb									
Non-native Grassland	-	-	0.13	0.83	2.76	5.08	-	-	8.79
Non-native Vegetation	-	-	-	-	0.45	-	-	-	0.45
Purple Needlegrass	-	-	-	-	-	0.67	-	-	0.67

Plant Community Type	Temporary Impact Acreages within the Project Area								
	Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Temporary Construction Lay-down Area	Bi-directional Pipeline[2] and Booster Pump Stations			FPUD WTP	Project Total
	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	Non-DOD	
Subtotal	***0.00***	***0.00***	***0.13***	***0.83***	***3.21***	***5.75***	***0.00***	***0.00***	***9.91***
Upland Woodland									
Eucalyptus Woodland	-	0.22	0.13	-	0.90	0.49	-	-	1.73
Coast Live Oak Woodland	-	-	-	-	0.03	0.58	-	-	0.61
Subtotal	***0.00***	***0.22***	***0.13***	***0.00***	***0.92***	***1.07***	***0.00***	***0.00***	***2.34***
Disturbed/Developed									
Disturbed and Developed Habitat	0.05	1.59	4.73	0.11	14.59	3.22	43.96	2.15	70.41
Subtotal	***0.05***	***1.59***	***4.73***	***0.11***	***14.59***	***3.22***	***43.96***	***2.15***	***70.41***
Total	**1.43**	**11.58**	**16.69**	**0.95**	**26.74**	**26.81**	**43.96**	**2.15**	**130.31**

[1] Impacts to Waters of the United States (WOTUS) are included in the overall temporary impact acreage impact assessment for riparian habitat, and not separated out in this analysis.

[2]For temporary impacts to the Bi-directional Pipeline, it is estimated that construction will require 50 feet out of the 100 foot wide footprint in straight segments, plus additional width when the pipeline turns corners; therefore, 60% of the overall vegetation impacts to the 100 foot corridor was used as an acreage impact. Appendix A Figures depict 100%, rather than 60%, for illustration purposes.

FPUD = Fallbrook Public Utility District; WTP = Water Treatment Plant; MCB = Marine Corps Base; DET Fallbrook = Naval Weapons Station, Detachment Fallbrook; DOD = Department of Defense.

Table C-3. Potential Permanent Impacts to Plant Communities within the Santa Margarita River Conjunctive Use Project Area for the Alternative 2

Plant Community Type	Permanent Impact Acreages within the Project Area								
	Recharge Ponds	Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Bi-directional Pipeline and Booster Pump Stations			Gallery Wells	Project Total
	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	MCB Camp Pendleton	
Riparian									
Non-native Riparian (NNR)	-	-	-	-	-	-	-	0.09	0.09
Sycamore Grassland (SG)	-	-	0.63	-	-	-	-	-	0.63
Southern Riparian Scrub (SRS)	-	0.30	0.68	0.80	-	-	-	0.89	2.67
Southern Riparian Woodland (SRW)	-	0.41	0.11	0.07	-	-	-	3.21	3.80
Subtotal	***0.00***	***0.71***	***1.42***	***0.87***	***0.00***	***0.00***	***0.00***	***4.19***	***7.19***
Upland Scrub									
Diegan Coastal Sage Scrub: Baccharis dominated (CSSB)	-	-	-	-	0.02	-	-	-	0.02
Diegan Coastal Sage Scrub (DCSS)	-	0.26	0.23	-	0.16	-	-	-	0.65
Southern Mixed Chaparral (SMC)	-	-	-	-	-	0.004	-	-	0.004
Subtotal	***0.00***	***0.26***	***0.23***	***0.00***	***0.18***	***0.004***	***0.00***	***0.00***	***0.67***
Upland Grassland/Herb									
Non-Native Grassland: Broadleaf-dominated (NNGB)	-	0.06	0.56	0.83	-	-	-	0.03	***1.48***
Subtotal	***0.00***	***0.06***	***0.56***	***0.83***	***0.00***	***0.00***	***0.00***	***0.03***	***1.48***

Plant Community Type	Permanent Impact Acreages within the Project Area								
	Recharge Ponds	Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Bi-directional Pipeline and Booster Pump Stations			Gallery Wells	Project Total
	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	MCB Camp Pendleton	
Bottomland									
Non-Vegetated Floodplain/Channel (FLO)	-	0.10	-	-	-	-	-	-	***0.10***
Freshwater Marsh (FWM)	-	0.23	-	-	-	-	-	-	***0.23***
Subtotal	***0.00***	***0.33***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.33***
Upland Woodland									
Eucalyptus Woodland (EUC))	-	-	0.05	-	-	-	-	-	***2.93***
Subtotal	***0.00***	***0.00***	***0.05***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.05***
Disturbed/Developed									
Urban/Developed (DEV)	-	0.0004	0.06	0.03	0.08	-	0.21	0.05	0.43
Subtotal	***0.00***	***0.0004***	***0.06***	***0.03***	***0.08***	***0.00***	***0.21***	***0.05***	***0.43***
Total	**0.00**	**1.36**	**2.32**	**1.73**	**0.26**	**0.004**	**0.21**	**4.27**	**10.15**

FPUD = Fallbrook Public Utility District; WTP = Water Treatment Plant; MCB = Marine Corps Base; DET Fallbrook = Naval Weapons Station, Detachment Fallbrook; DOD = Department of Defense.

Table C-4. Potential Temporary Impacts to Plant Communities within the Santa Margarita River Conjunctive Use Project Area for Alternative 2

Plant Community Type	Temporary Impact Acreages within the Project Area								
	Recharge Ponds	Diversion Weir	O'Neill Ditch	Production Wells, Conveyance Pipelines, and Permanent Access Roads	Bi-directional Pipeline and Booster Pump Stations			Gallery Wells	Project Total
	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	MCB Camp Pendleton	DET Fallbrook	Non-DOD	MCB Camp Pendleton	
Riparian									
Southern Coast Live Oak Riparian Forest	-	-	-	-	-	1.15	-	-	1.15
Southern Cottonwood-willow Riparian Forest (CWRF)	-	-	-	-	-	-	0.64	-	0.64
Mule-fat Scrub (MFS)	-	-	-	0.24	0.18	-	-	-	0.42
Non-native Riparian (NNR)	-	-	-	0.08	-	-	-	0.07	0.16
Sycamore Grassland (SG)	0.33	-	2.12	0.28	-	-	-	-	2.73
Southern Riparian Forest (SRF)	-	-	-	-	0.25	-	-	-	0.25
Southern Riparian Scrub (SRS)	1.87	0.06	1.06	5.28	0.77	1.00	-	0.76	10.80
Southern Riparian Woodland (SRW)	1.65	0.47	0.74	3.32	-	-	-	1.34	7.52
Southern Arroyo Willow Riparian Forest	-	-	-	0.02	-	-	-	-	0.02
Southern Willow Scrub (SWS)	-	-	-	0.01	-	-	-	-	0.01
Subtotal	***3.85***	***0.53***	***3.92***	***9.24***	***1.21***	***2.15***	***0.64***	***2.17***	***23.71***
Upland Scrub									

Plant Community Type	Temporary Impact Acreages within the Project Area								
	Recharge Ponds	**Diversion Weir**	**O'Neill Ditch**	**Production Wells, Conveyance Pipelines, and Permanent Access Roads**	**Bi-directional Pipeline and Booster Pump Stations**			**Gallery Wells**	**Project Total**
	MCB Camp Pendleton	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**DET Fallbrook**	**Non-DOD**	**MCB Camp Pendleton**	
Diegan Coastal Sage Scrub: Baccharis dominated (CSSB)	-	-	-	0.09	0.80	-	-	-	0.89
Coastal Sage-Chaparral Scrub (CSS-CHAP)	-	-	-	0.10	2.97	-	-	-	3.07
Diegan Coastal Sage Scrub (DCSS)	0.08	0.21	1.83	0.01	11.35	28.11	0.01	-	41.60
Southern Mixed Chaparral (SMC)	-	-	-	-	-	-	3.43	-	3.43
Subtotal	***0.08***	***0.21***	***1.83***	***0.20***	***15.11***	***28.11***	***3.44***	***0.00***	***48.98***
Upland Grassland/Herb									
Non-native Grassland (NNG)	-	-	-	0.13	3.09	13.59	1.89	-	***18.69***
Non-Native Grassland: Broadleaf-dominated (NNGB)	6.00	0.25	3.76	3.49	-	-	-	-	***13.51***
Valley Needlegrass Grassland (VNG)	-	-	-	-	-	1.27	-	-	***1.27***
Subtotal	***6.00***	***0.25***	***3.76***	***3.61***	***3.09***	***14.86***	***1.89***	***0.00***	***33.46***
Bottomland									
Coastal and Valley Freshwater Marsh (CVFM)	-	-	-	0.01	-	-	-	-	***0.01***
Non-Vegetated Floodplain/Channel (FLO)	0.27	0.06	-	-	-	-	-	0.11	***0.44***
Freshwater Marsh (FWM)	-	0.40	0.01	-	-	0.75	-	-	***1.16***
Open Water (OW)	-	-	0.02	0.07	-	-	-	-	***0.09***

Plant Community Type	Temporary Impact Acreages within the Project Area								
	Recharge Ponds	**Diversion Weir**	**O'Neill Ditch**	**Production Wells, Conveyance Pipelines, and Permanent Access Roads**	**Bi-directional Pipeline and Booster Pump Stations**			**Gallery Wells**	**Project Total**
	MCB Camp Pendleton	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**MCB Camp Pendleton**	**DET Fallbrook**	**Non-DOD**	**MCB Camp Pendleton**	
Subtotal	***0.27***	***0.46***	***0.03***	***0.08***	***0.00***	***0.75***	***0.00***	***0.11***	***1.70***
Upland Woodland									
Coast Live Oak Woodland (CLO)	-	-	-	-	-	-	0.85	-	***0.85***
Eucalyptus Woodland (EUC))	-	-	0.22	0.001	1.13	1.56	0.02	-	***2.93***
Subtotal	***0.00***	***0.00***	***0.05***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.05***
Disturbed/Developed									
Agriculture (AGR)	-	-	-	-	-	-	11.13	-	11.13
Urban/Developed (DEV)	4.46	0.05	1.90	3.96	21.01	12.59	21.45	0.03	65.45
Disturbed Habitat (DIST)	-	-	-	0.10	0.21	2.25	-	-	2.57
Subtotal	***4.46***	***0.05***	***1.90***	***4.06***	***21.22***	***14.84***	***32.58***	***0.03***	***79.14***
Total	**14.66**	**1.50**	**11.67**	**17.19**	**41.76**	**62.27**	**39.42**	**2.31**	**190.77**

FPUD = Fallbrook Public Utility District; WTP = Water Treatment Plant; MCB = Marine Corps Base; DET Fallbrook = Naval Weapons Station, Detachment Fallbrook; DOD = Department of Defense.

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New 6 M.G. Tank
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Temporary Impact Area
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DET Fallbrook Boundary
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Plant Communities for
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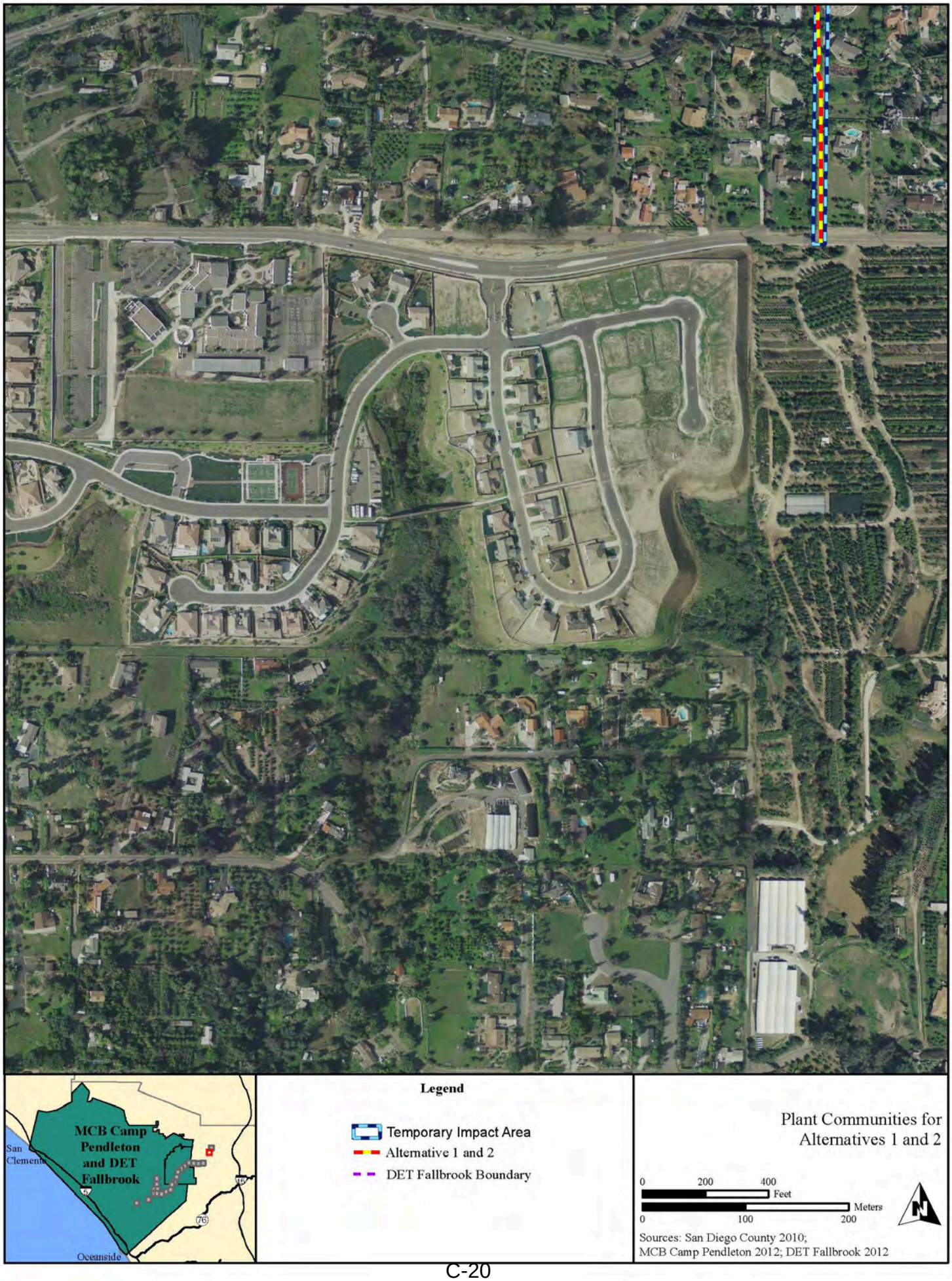
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012


MCB Camp Pendleton and DET Fallbrook
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Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012


MCB Camp Pendleton and DET Fallbrook
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Temporary Impact Area
Alternative 1 and 2
DET Fallbrook Boundary
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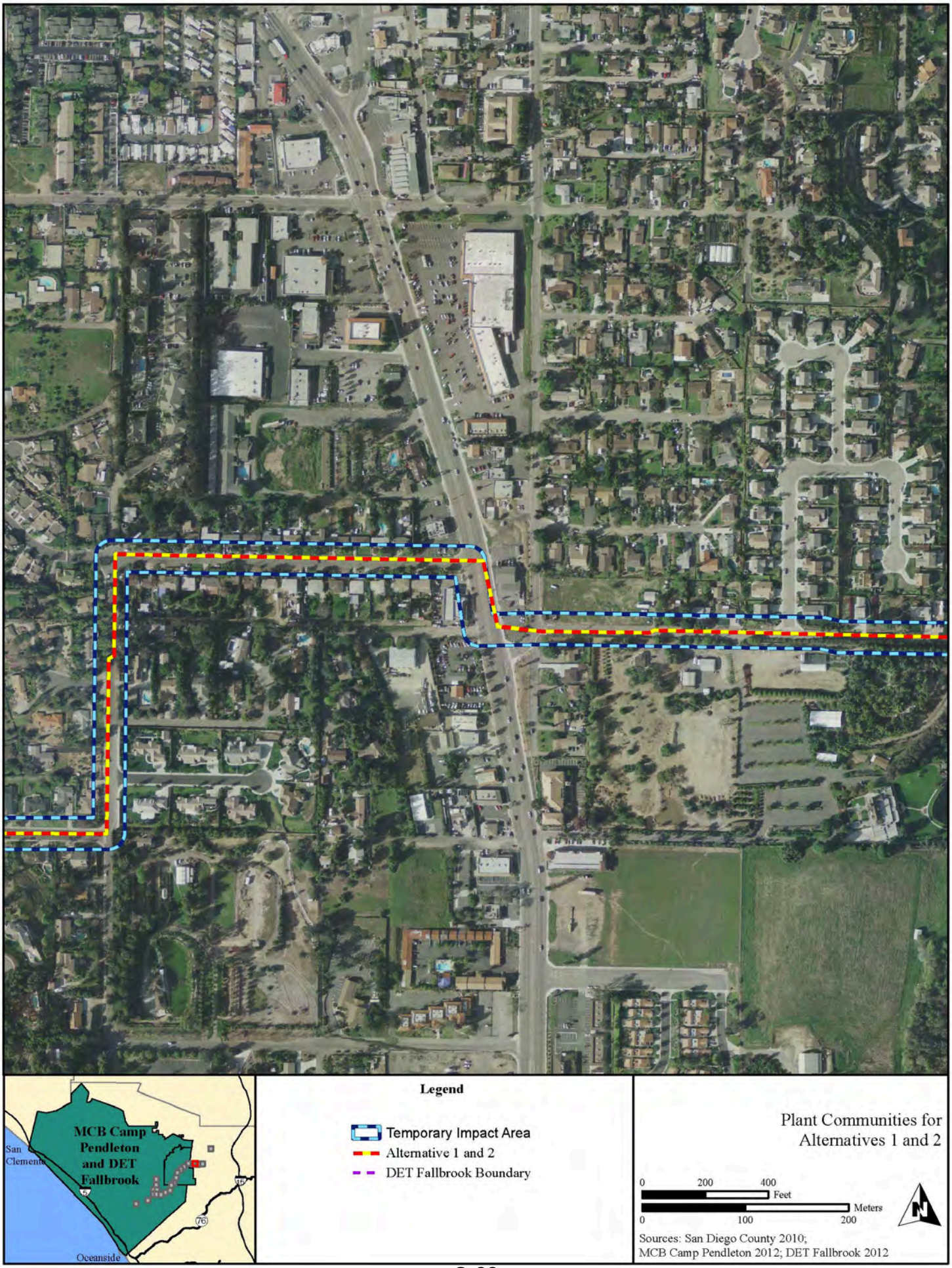
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012


MCB Camp Pendleton and DET Fallbrook
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Alternative 1 and 2
DET Fallbrook Boundary
Plant Communities for Alternatives 1 and 2
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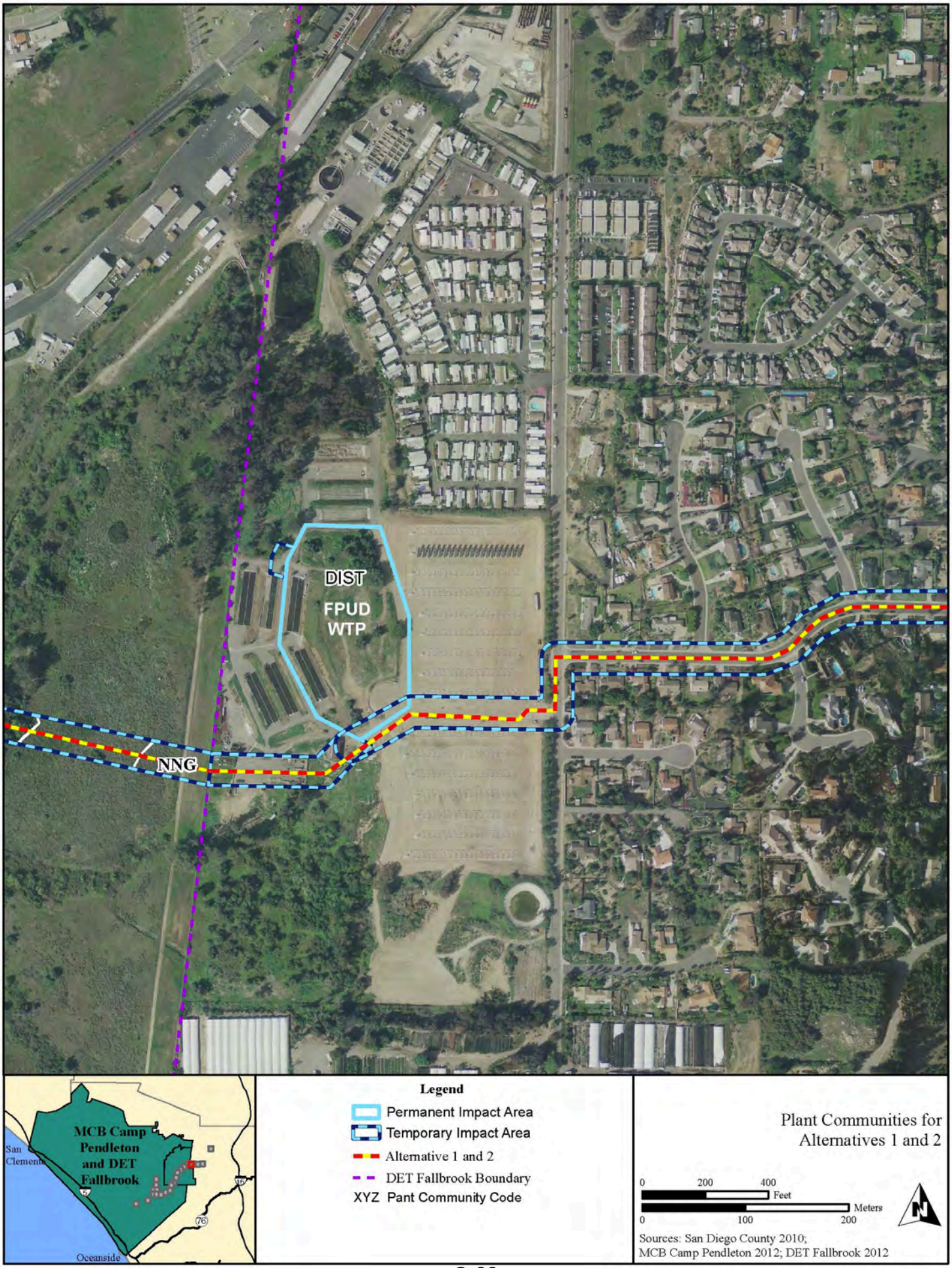
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012


DIST
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Temporary Impact Area
Alternative 1 and 2
DET Fallbrook Boundary
XYZ Pant Community Code
Plant Communities for
Alternatives 1 and 2
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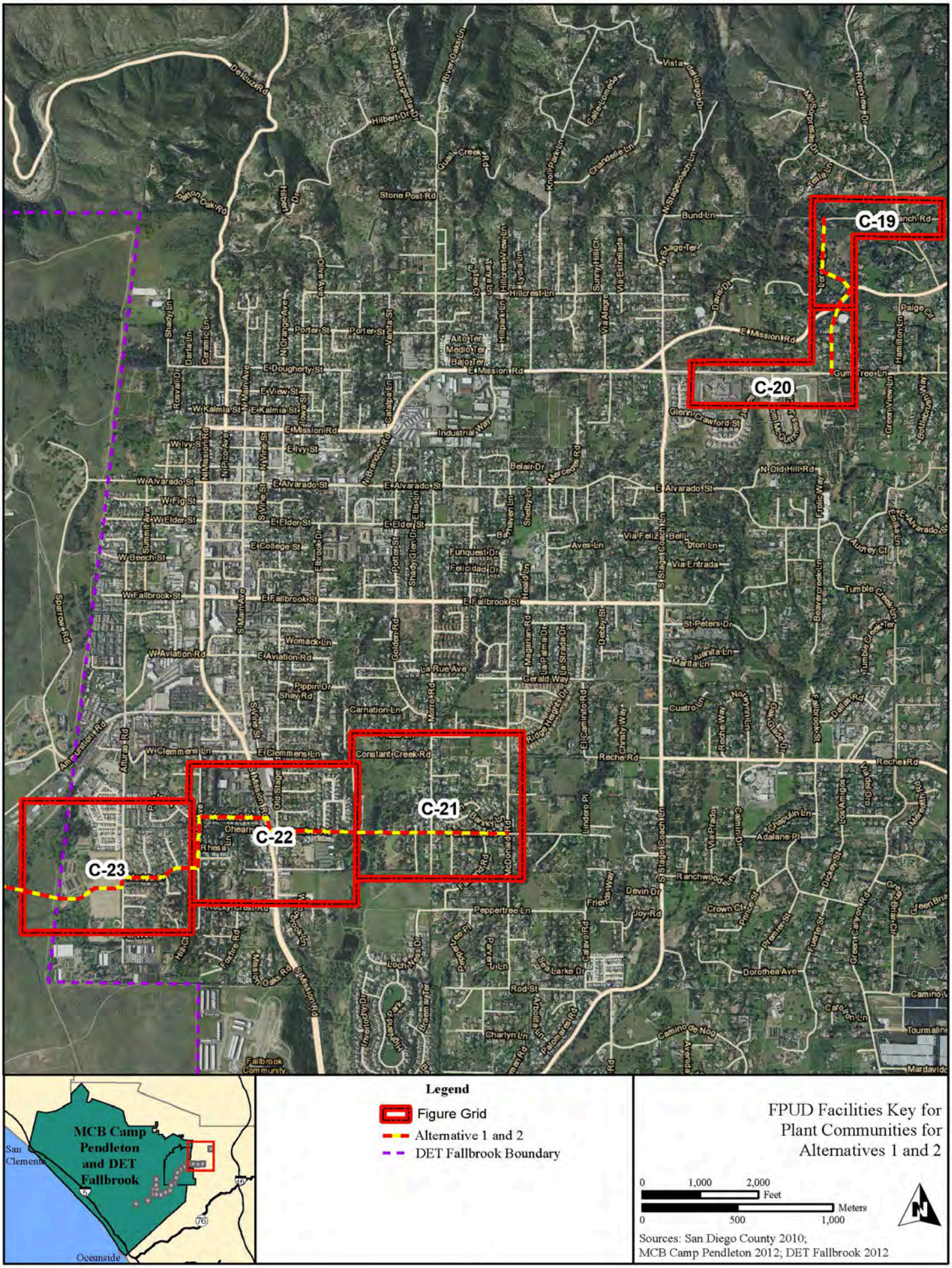
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012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Alternative 1 and 2
DET Fallbrook Boundary
MCB Camp Pendleton and DET Fallbrook
San Clemente
Oceanside
FPUD Facilities Key for Plant Communities for Alternatives 1 and 2
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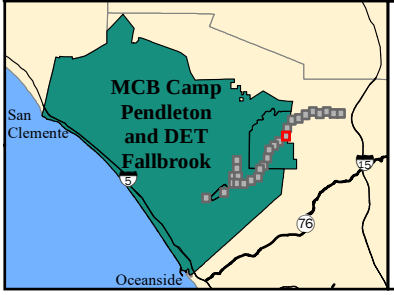
Sources: San Diego County 2010; MCB Camp Pendleton 2012; DET Fallbrook 2012



Legend

- Permanent Impact Area
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- Alternative 1 and 2
- Alternative 1
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- DET Fallbrook Boundary
- XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

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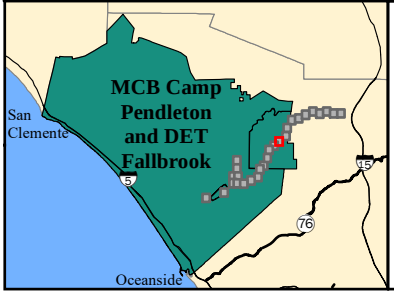
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



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XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

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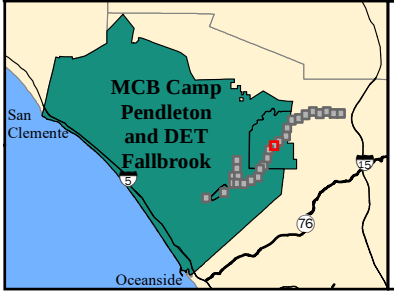
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



Legend

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Plant Communities for Alternatives 1 and 2

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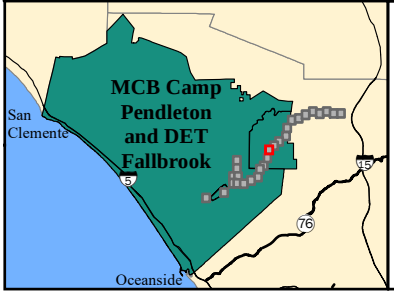
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



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- Alternative 1 and 2
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Plant Communities for Alternatives 1 and 2

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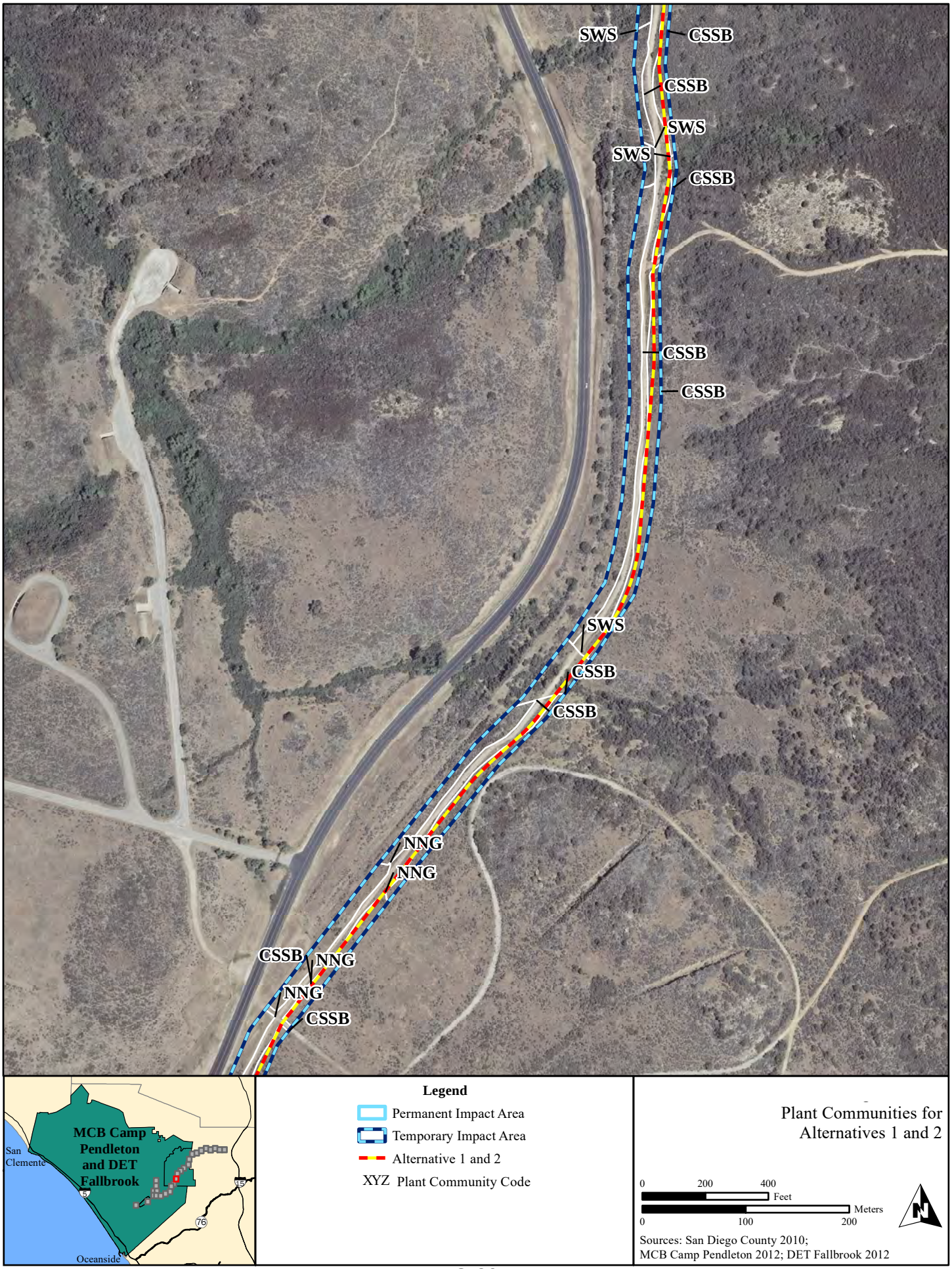
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012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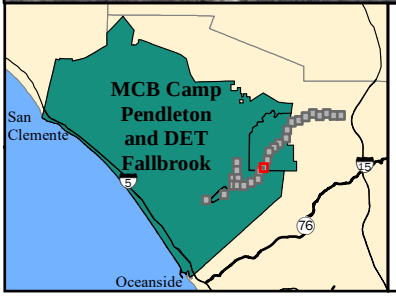
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



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- Permanent Impact Area
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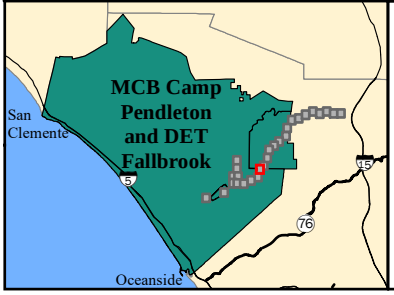
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



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Plant Communities for Alternatives 1 and 2

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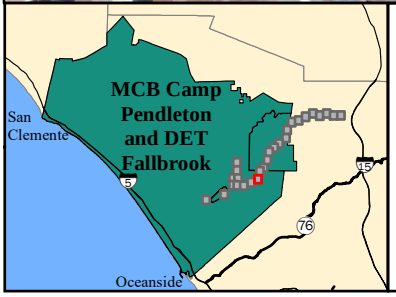
Sources: San Diego County 2010; MCB Camp Pendleton 2012; DET Fallbrook 2012



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Plant Communities for Alternatives 1 and 2

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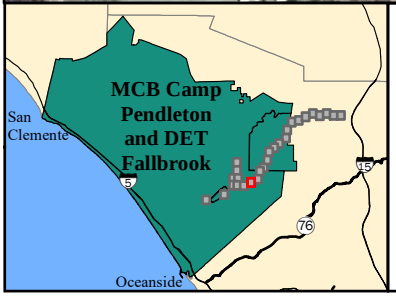
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



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Plant Communities for Alternatives 1 and 2

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Sources: San Diego County 2010; MCB Camp Pendleton 2012; DET Fallbrook 2012


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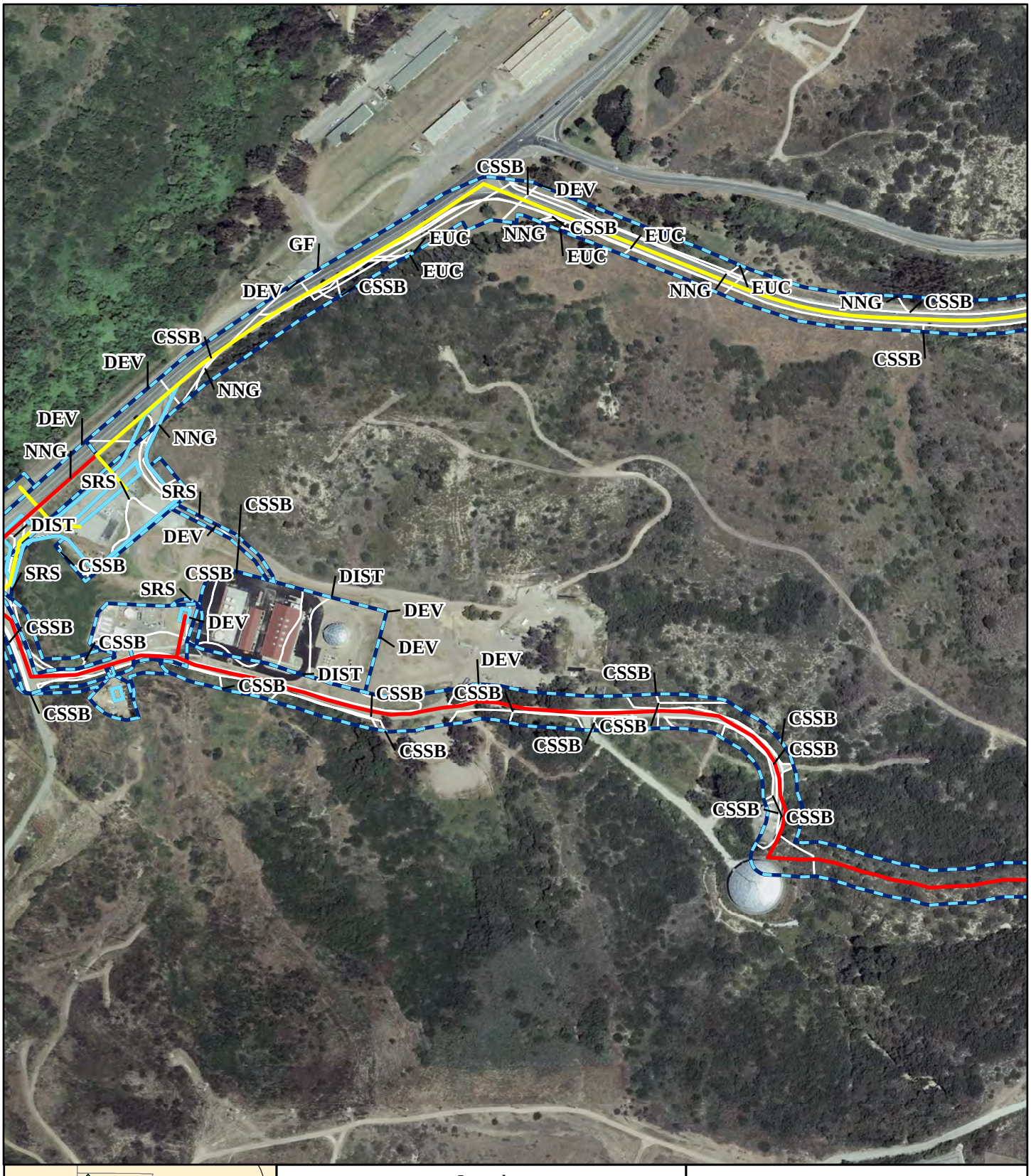
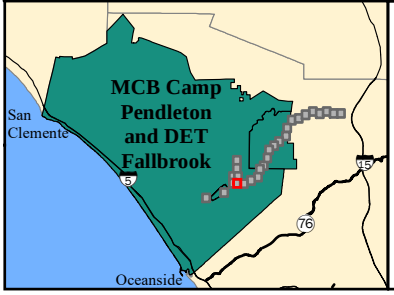
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012





Legend

- Permanent Impact Area
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- XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

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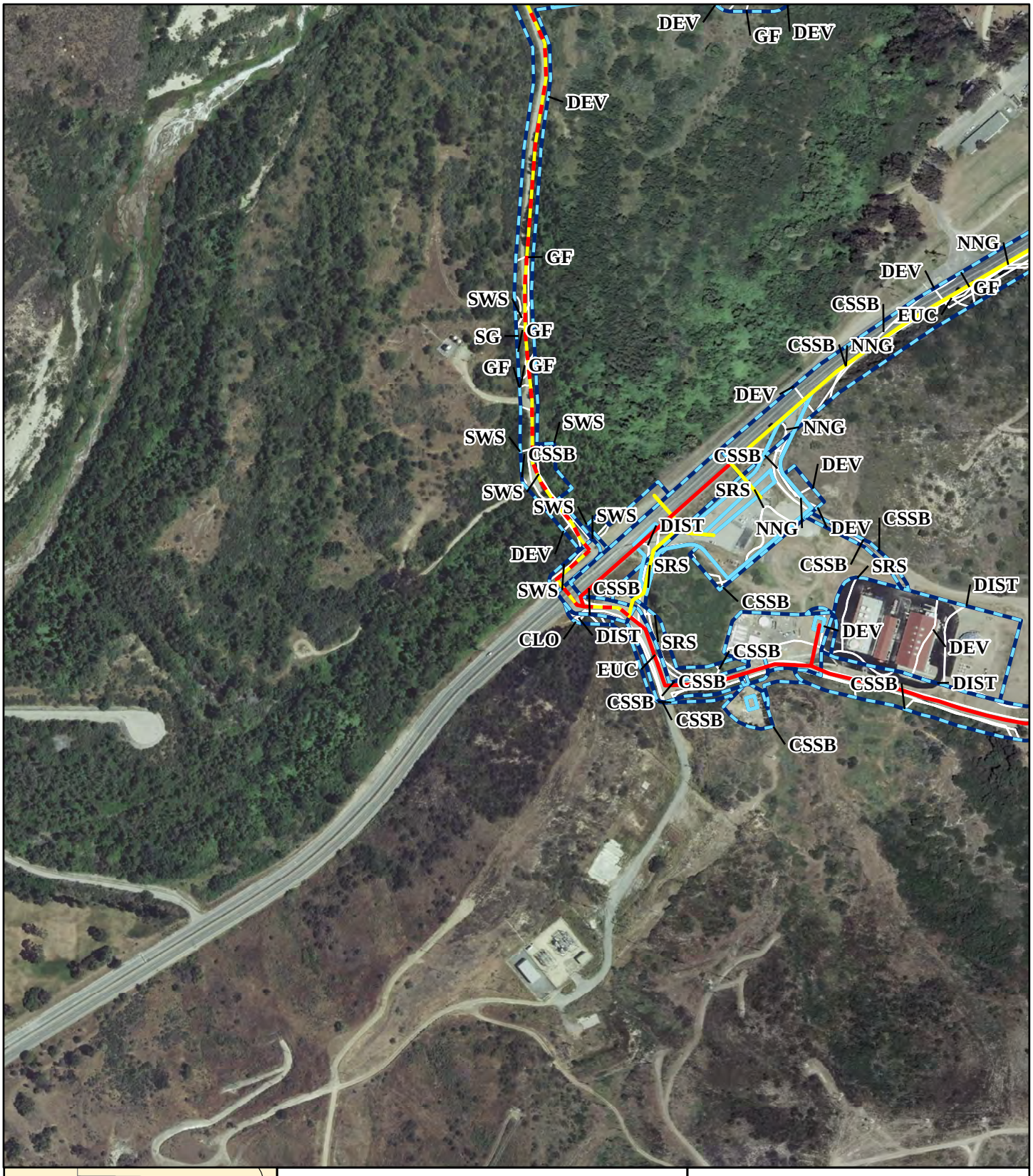
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012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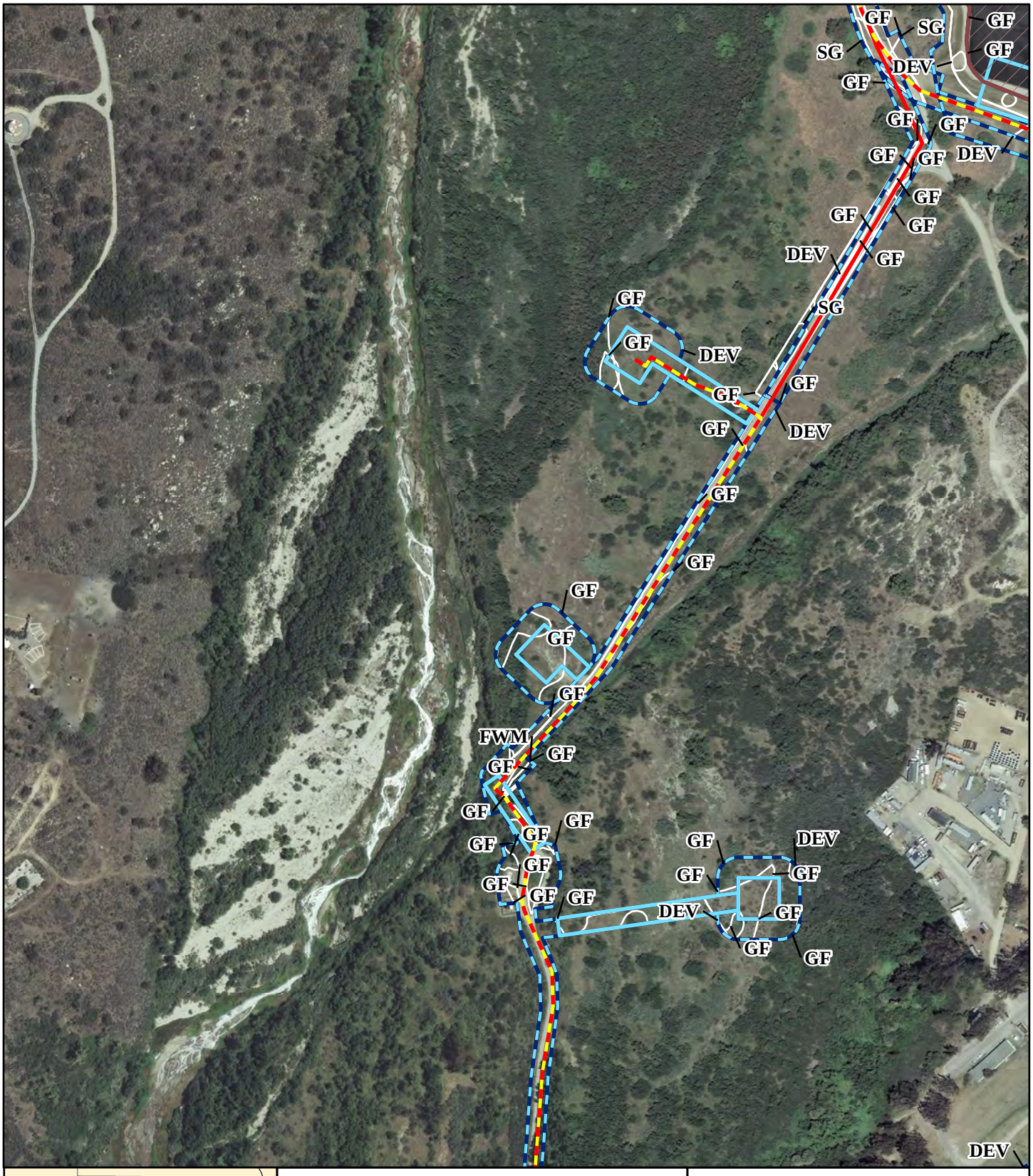
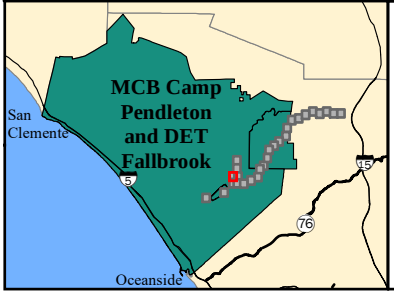
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012





Legend

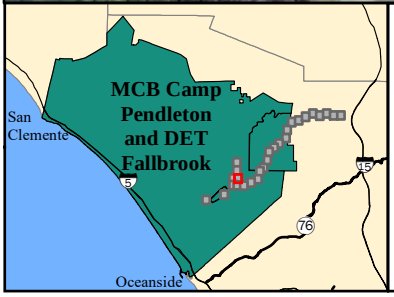
- Permanent Impact Area
- Temporary Impact Area
- Alternative 1 and 2
- Alternative 2
- Recharge Ponds 1-7
- XYZ Plant Community Code

Plant Communities for
Alternatives 1 and 2

0 200 400 Feet

0 100 200 Meters

Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



Legend

- Permanent Impact Area
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- Alternative 1 and 2
- Alternative 1
- Alternative 2
- Recharge Ponds 1-7
- XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

0 200 400 Feet

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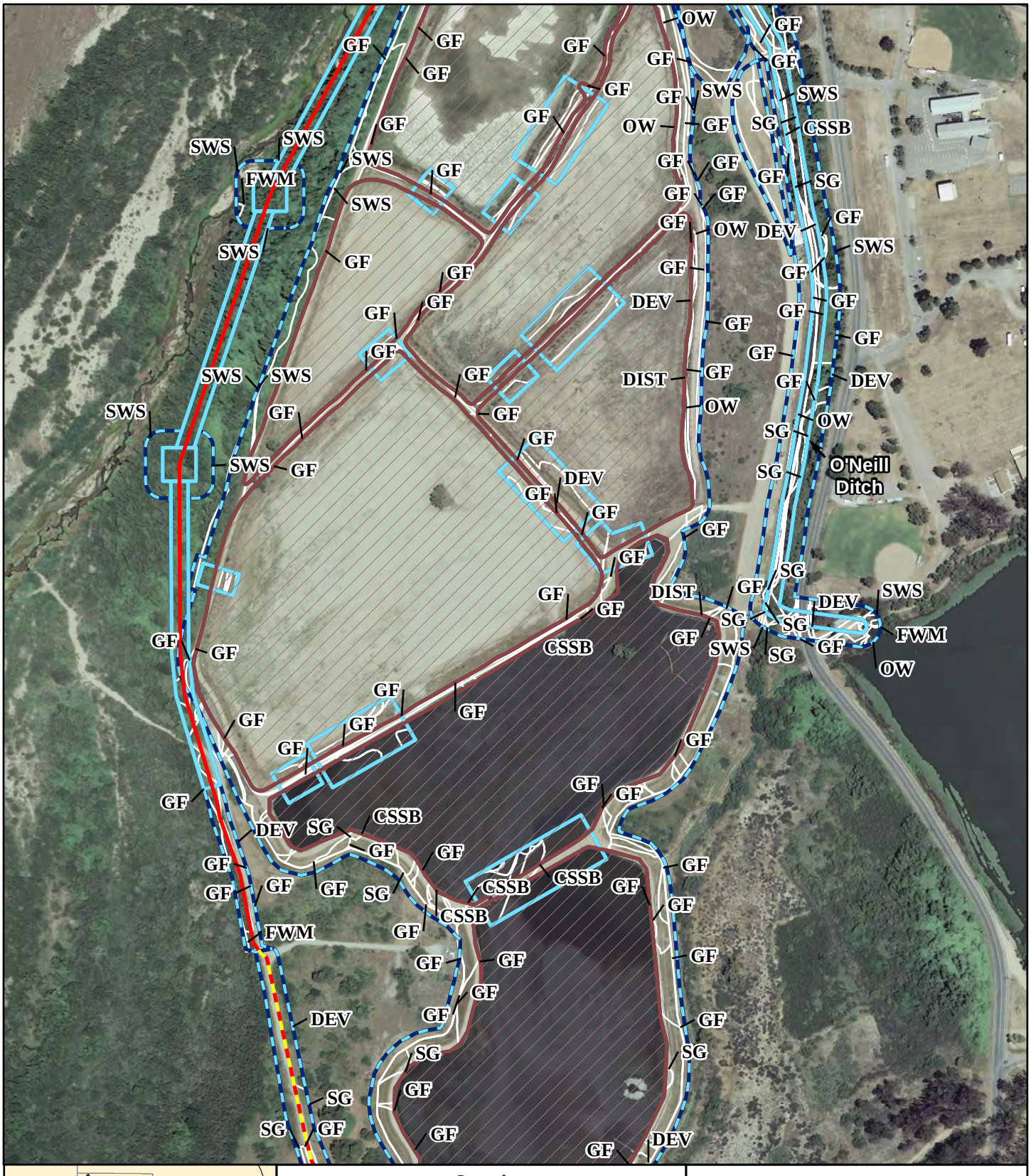
Sources: San Diego County 2010; MCB Camp Pendleton 2012; DET Fallbrook 2012


O'Neill Ditch
MCB Camp Pendleton and DET Fallbrook
San Clemente
Oceanside
Legend
Permanent Impact Area
Temporary Impact Area
Alternative 1 and 2
Alternative 2
Recharge Ponds 1-7
XYZ Plant Community Code
Plant Communities for Alternatives 1 and 2
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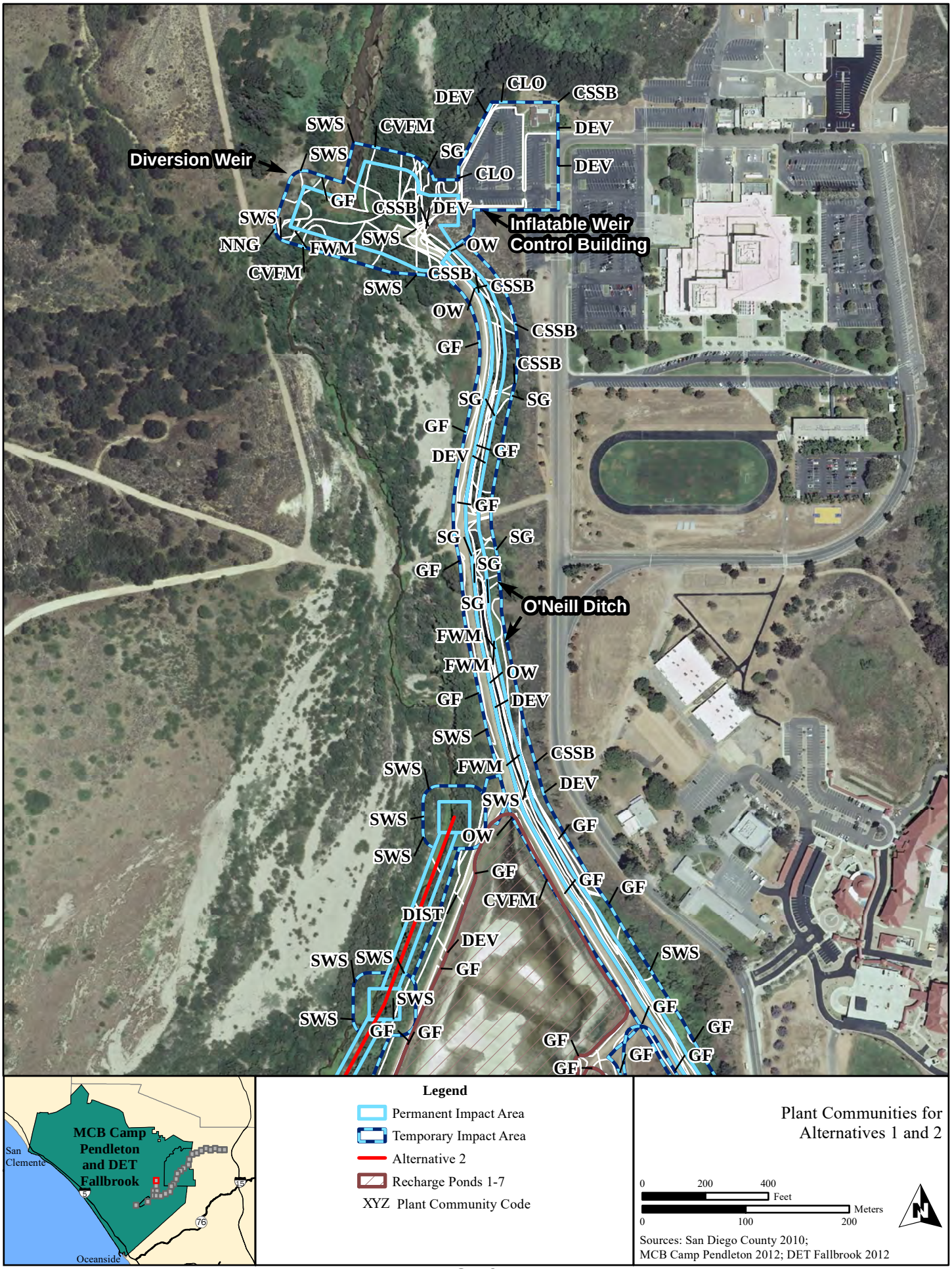
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012


Diversion Weir
Inflatable Weir
Control Building
O'Neill Ditch
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CVFM
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FWM
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San Clemente
Oceanside
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Permanent Impact Area
Temporary Impact Area
Alternative 2
Recharge Ponds 1-7
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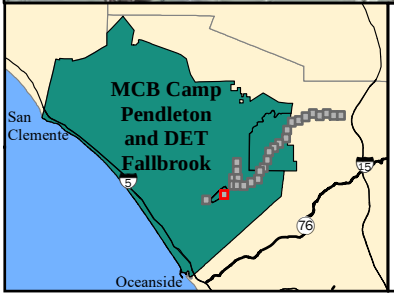
Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012



Legend

Permanent Impact Area

Temporary Impact Area

XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

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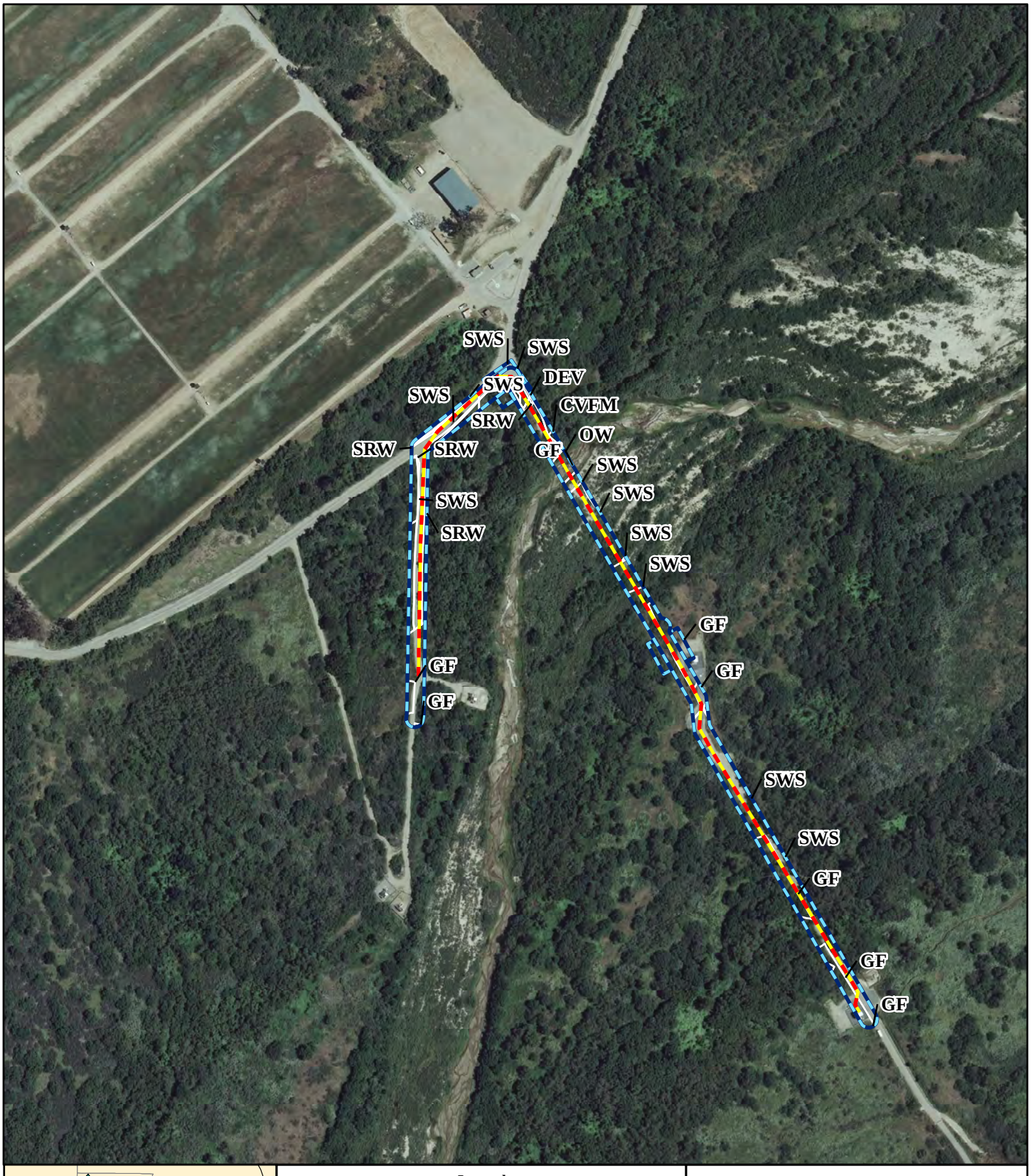
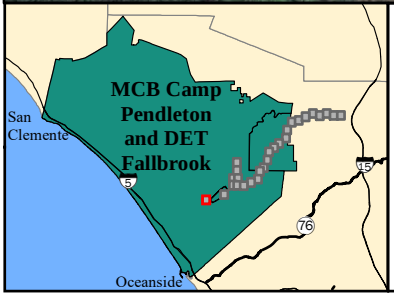
Sources: San Diego County 2010; MCB Camp Pendleton 2012; DET Fallbrook 2012





Legend

- Permanent Impact Area
- Temporary Impact Area
- Alternative 1 and 2
- XYZ Plant Community Code

Plant Communities for Alternatives 1 and 2

0 200 400 Feet

0 100 200 Meters

Sources: San Diego County 2010;
MCB Camp Pendleton 2012; DET Fallbrook 2012

Appendix C-2

Threatened & Endangered Species Figures

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A DESCRIPTION OF FEDERALLY- AND STATE-LISTED SPECIES THAT MAY BE AFFECTED BY THE ACTION

Alternative 1 and Alternative 2 overlaps a number of federally- and state-listed species habitats resulting in a diverse assemblage within or adjacent to the project area (Overview in Figure C-1; Grids A-D in the Overview are in Figures C-2 to C-5). Those species addressed in this appendix are those known or reasonably likely to occur in the Action Area of both Alternatives, with this analysis conducted for the USFWS Section 7 Consultation for Alternative 1. The Action Area consists of MCB Camp Pendleton and Detachment Fallbrook; the City of Fallbrook is omitted for there are no expected impacts to listed species. Stephens' kangaroo rat habitat is depicted in Section C-5 of this appendix.

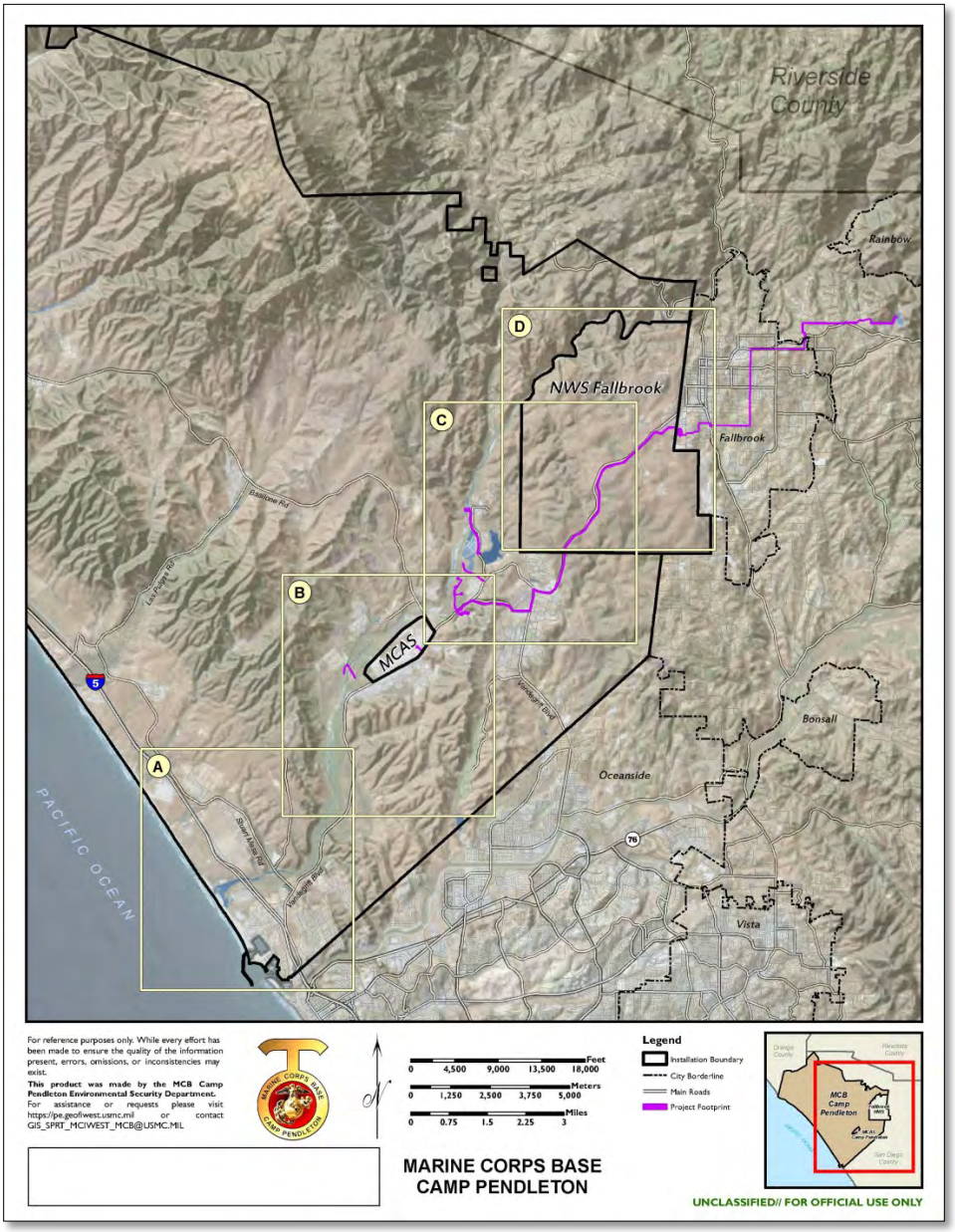

Figure C-1. Overview of the Action Area.

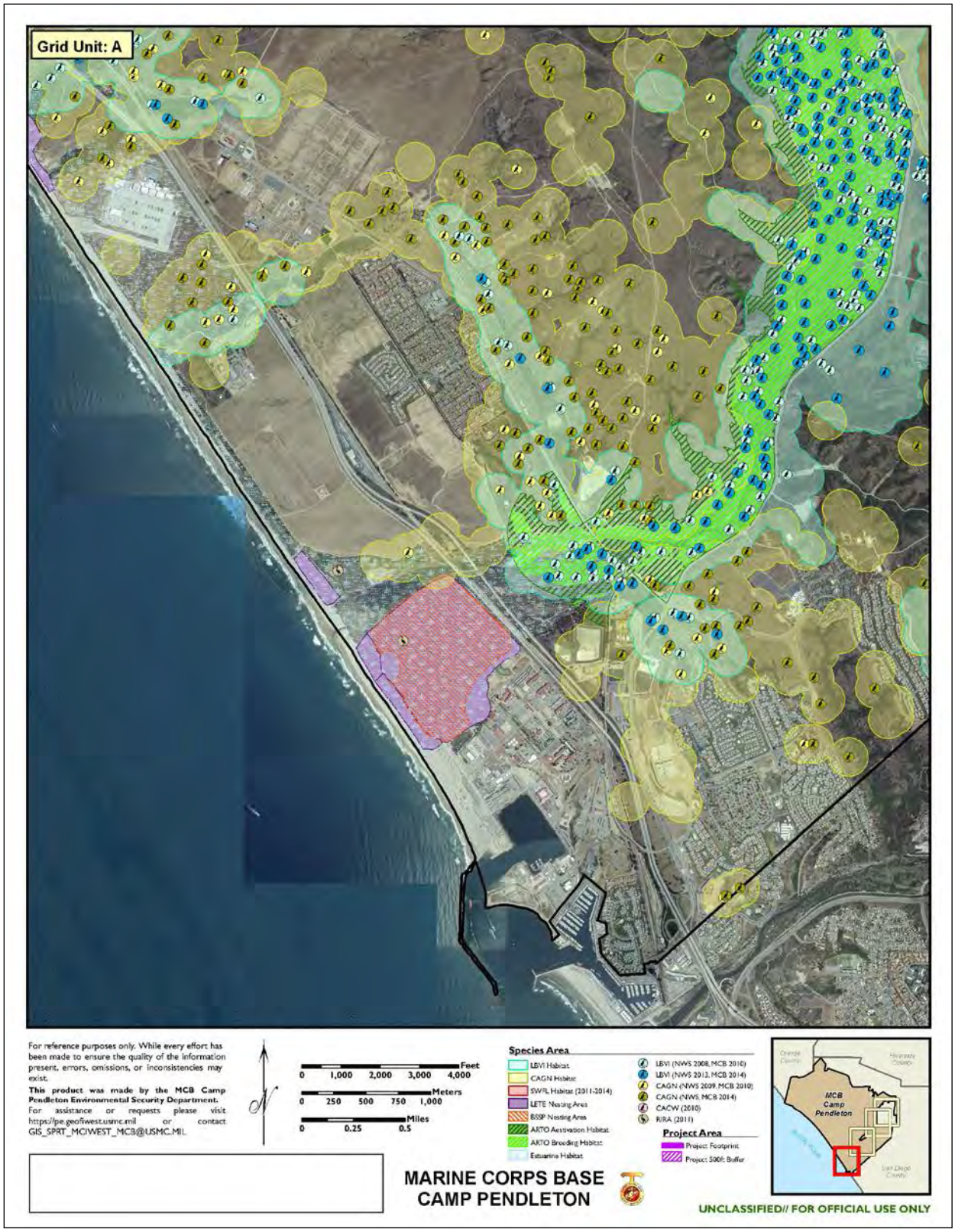

Figure C-2. Listed Species Locations within the Action Area. Grid A.

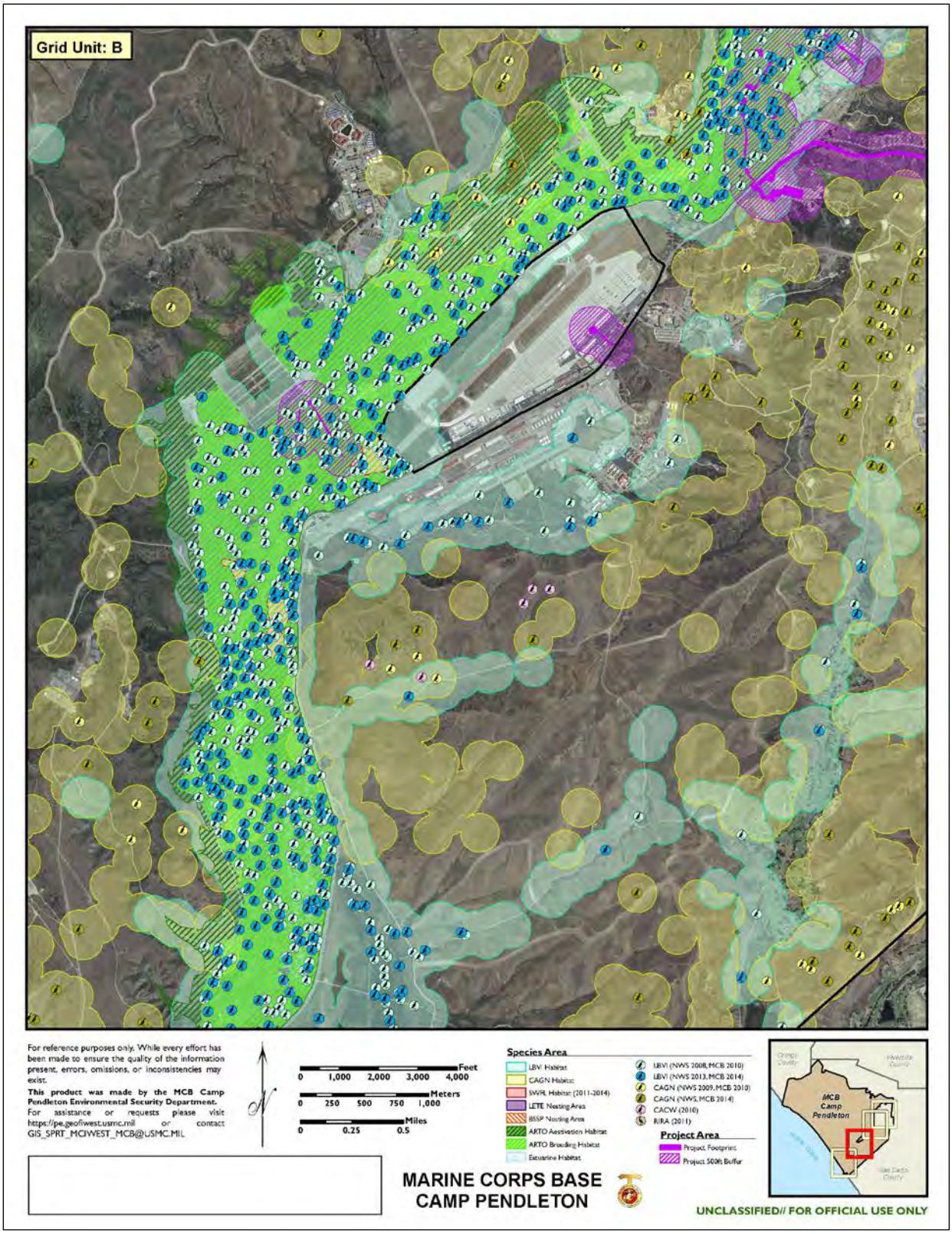

Figure C-3. Listed Species Locations within the Action Area. Grid B.

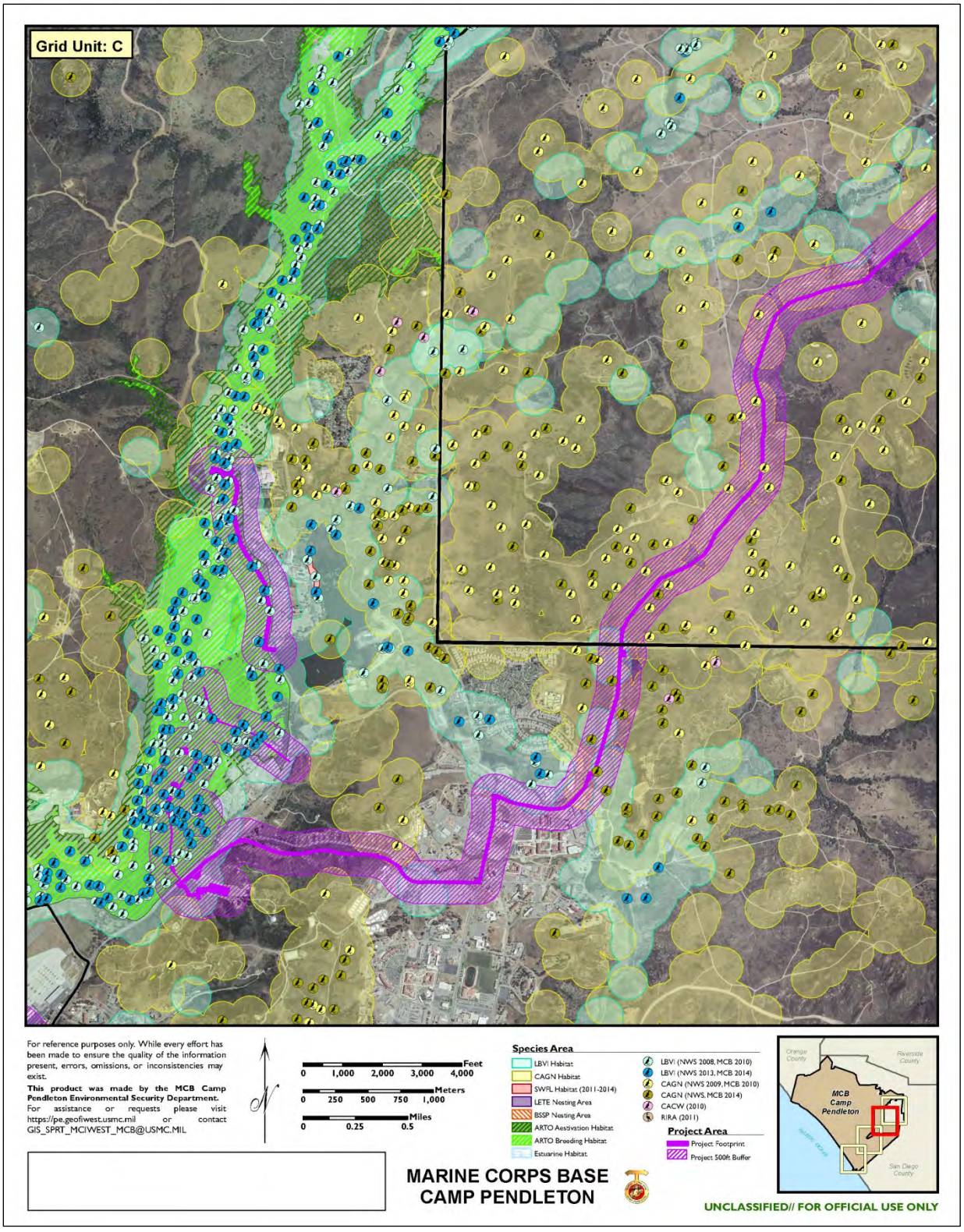

Figure C-4. Listed Species Locations within the Action Area. Grid C.

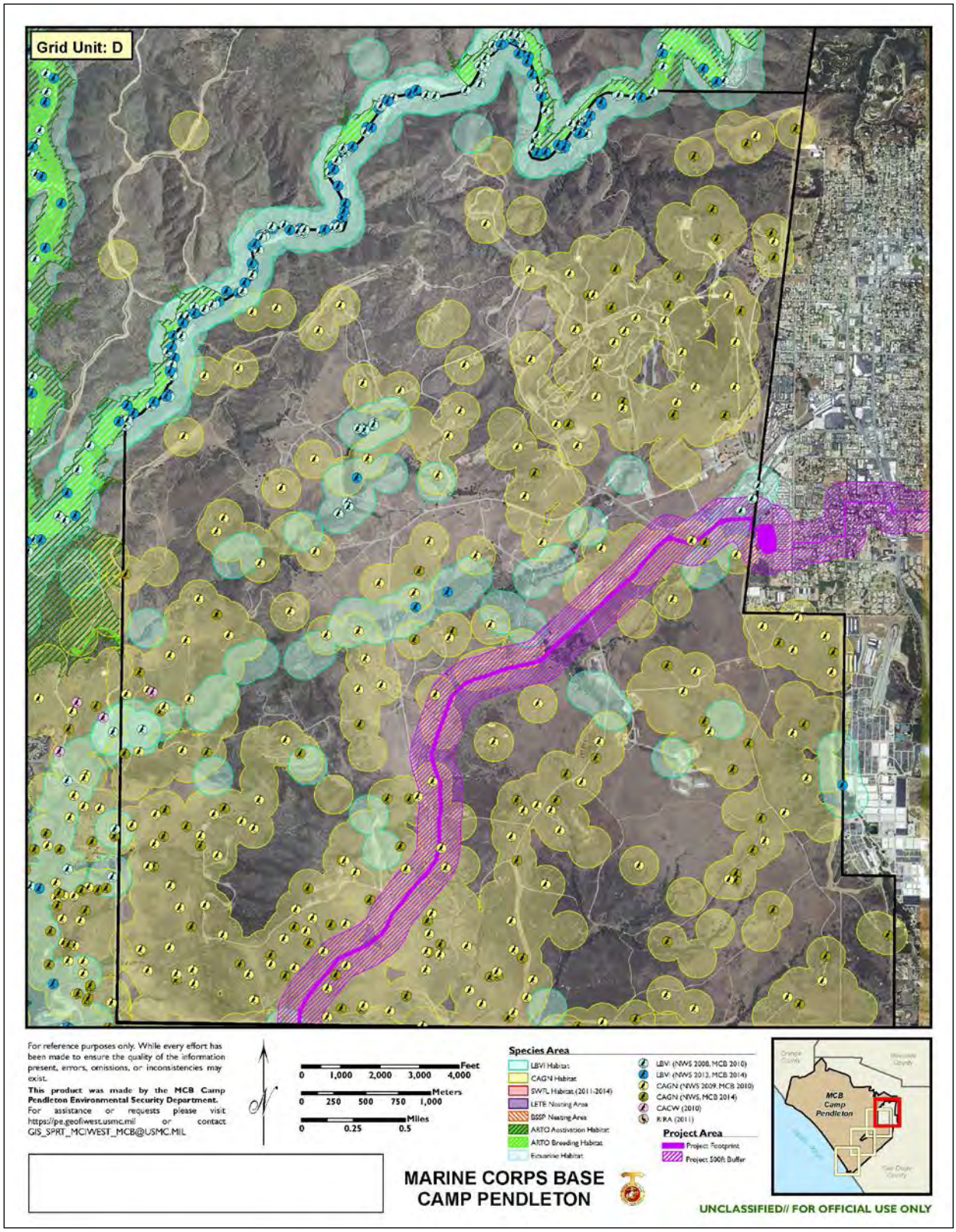

Figure C-5. Listed Species Locations within the Action Area. Grid D.

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Appendix C-3

OSMZ

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Final Botanical Survey Report

Santa Margarita River Conjunctive Use Project

Open Space Management Zone Fallbrook Public Utility District, California

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INTRODUCTION

This report documents the results of botanical surveys conducted between March and July, 2008, of a proposed 1,384-acre Open Space Management Zone (OSMZ) in Fallbrook, San Diego County, California. The designation of the OSMZ is proposed as part of the Santa Margarita River (SMR) Conjunctive Use Project (CUP) currently under review by the U.S. Bureau of Reclamation, Marine Corps Base Camp Pendleton, and the Fallbrook Public Utility District (FPUD). The OSMZ is owned by the FPUD and is at the site of the formerly proposed Fallbrook Dam and Reservoir. The OSMZ would be included in the CUP to help protect water quality and allow for passive recreation use. Mitigation, if required for other elements of the CUP, could also be incorporated into the OSMZ.

The scope of the botanical surveys was to conduct three complete surveys of the OSMZ, with surveys approximately six weeks apart in order to overlap the appropriate season(s) for detecting all potentially occurring rare plants. Federally and state-listed plant species, as well as California Native Plant Society (CNPS) list 1B through 4 species were searched for.

METHODOLOGY

TEC conducted database searches and a three-visit botanical inventory for the 1,384-acre OSMZ in accordance with *Guidelines for Conducting and Reporting Botanical Inventories for Federally listed, Proposed and Candidate Plants* (U.S. Fish and Wildlife Service 1996), *Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, or Endangered Plants and Natural Communities* (California Department of Fish and Game 2000), and *Botanical Survey Guidelines of the California Native Plant Society* (CNPS) (CNPS 2001). Surveys were conducted at the rate of approximately 100 acres per person per day. Thus, it required 14 person-days for each of the three surveys (42 person-days total).

The 1,384-acre OSMZ is within the Fallbrook and Temecula quadrangles. TEC Inc. ordered and reviewed California Department of Fish and Game (CDFG) California Natural Diversity Database (CNDDB) data for rare, threatened, endangered, and sensitive animals, plants, and natural communities for the Fallbrook and Temecula quadrangles. San Diego County Association of Governments (SANDAG 1995) vegetation mapping was used to create vegetation maps of the OSMZ. These maps are provided as Figures 1 through 9 at the end of this report.

Plant surveys were conducted throughout the 1,384-acre OSMZ. However, some steep chaparral slopes and dense riparian areas were inaccessible and Urban/Developed areas were not surveyed. TEC and TEC-subcontractor biologists surveyed for all potentially occurring federally and state-listed and proposed species and CNPS list 1B through 4 species. List 1B species are rare throughout their range and occur primarily within California. List 2 species are rare in California, but more widespread outside the State. List 3 species appear to be rare but require more information to determine appropriate rank. List 4 species have restricted distribution within California. Biologists Carolyn Martus (independent consultant) and Margie Mulligan (San Diego Natural History Museum), along with Melissa Tu of TEC, conducted the surveys. Surveys were conducted from March through July 2008. The first survey was conducted from March 17 through April 4, the second survey was conducted from April 28 through May 16, and the third survey was conducted form June 9 through July 16, 2008.

RESULTS

At least 318 plant species, 237 of which are native, were documented within the OSMZ during the surveys. Appendix A includes the list of all plant species encountered. The majority of the OSMZ is native vegetation except for some avocado groves and houses that are within the edges of the footprint,

and a few roads that go though the OSMZ. There are heavily used dirt trails through the OSMZ especially along the SMR. People were observed fishing and people and dogs were observed swimming at the convergence of Sandia Creek and the SMR. The steep hillsides of the OSMZ are dominated by dense chaparral habitat with small patches of coastal sage scrub. Along Sandia Creek and the SMR are dense are of riparian forests dominated by willows (*Salix* sp.), sycamores (*Platanus racemosa)*, and cottonwoods (*Populus fremontii ssp. fremontii*). Areas along the south side of the SMR are dominated by dense coast live oak woodland. Portions of the OSMZ near the Sandia Creek and SMR burned during the October 2003 wildfire and large sections of the northeastern section of the OSMZ burned during the October 2007 wildfire. The chaparral habitat which burned in 2003 is recovering well. The northeastern section which burned in 2007 was dominated by California poppies (*Eschscholzia californica)* and *Phacelia* species during the spring. Photographs of the OSMZ, filed by date, are contained on a separate CD.

Rare plant species observed during the plant surveys are shown in Table 1 and Figures 2 through 9. No state or federally listed plant species were found during the plant surveys; however, five species of CNPS listed species were documented. Appendix B includes California Natural Diversity Database (CNDDB) forms and photographic documentation of rare plant species. Each rare plant is discussed below.

Table 1. Rare Plants Documented in the OSMZ

Common Name	Scientific Name	Family	Federal/ State/CNPS Status*	Approximate Population Size	Location on Figures
Rainbow Manzanita	*Arctostaphylos rainbowensis*	Ericaceae	1B.1	341	Figures 2-6
Chaparral sand-verbena	*Abronia villosa* var. *aurita*	Nyctaginaceae	1B.1	927	Figures 4-7
Fish's Milkwort	*Polygala cornuta* var. *fishiae*	Polygalaceae	4.3	2,085	Figures 7-8
Ocellated Humboldt lily	*Lilium humboldtii* var. *ocellatum*	Liliaceae	4.2	3	Figure 6
Engelmann Oak	*Quercus engelmannii*	Fagaceae	4.2	Undetermined	Not mapped

* California Native Plant Society List (CNPS) List:

1B - Plants considered rare or endangered in California and elsewhere

2 - Plants considered rare or endangered in California but more common elsewhere.

3 - Plants for which more information is needed.

4 - Plants of limited distribution – a watch list.

CNPS Threat Codes

.1 - Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)

.2 – Fairly endangered in California (20-80% occurrences threatened)

.3 – Not very endangered in California (<20% of occurrences threatened or no current threats known)

Rainbow Manzanita (*Arctostaphylos rainbowensi*), a CNPS list 1B species, was found in chaparral habitat within the OSMZ (Figures 2-6, photo below). This species is found in chaparral habitat and is restricted to southwestern Riverside County, south of Pauba Valley, and northeastern San Diego County, north of the San Luis Rey River, between 300 and 600 meters (Keeley and Massihi 1994). The species also occurs on Camp Pendleton. The CDFG CNDDB forms listed historical records of Rainbow

Manzanita from the town of Rainbow, the Santa Rosa Plateau, and southeast of the SMR and Gavilan Mountain peak; however, there were not any listing of Rainbow Manzanita with the OSMZ (CDFG 2008). Three hundred forty one individuals of Rainbow Manzanita were documented during 2008 plant surveys in chaparral habitat on the steep slopes east and west of Sandia Creek and on the slopes north and south of the SMR (Figures 2-6). Some of areas of chaparral were too steep and thick to walk through so this species was identified through binocular scans of the hillside. It is likely that there are more small pockets of Rainbow Manzanita within the OSMZ. CNDDB forms for Rainbow Manzanita are included in Appendix B.

Chaparral Sand-Verbena (*Abronia villosa* var. *aurita*), a CNPS list 1B.1 species, was found along sandy benches above Sandia Creek and the Santa Margarita River (SMR) (Figures 4-7, photo at right). The CDFG CNDDB forms listed a historical record of Chaparral Sand-Verbena in the SMR river ford north of Fallbrook from 1964 (CDFG 2008). Chaparral Sand-Verbena is typically found in chaparral habitat; however, within the OSMZ, Chaparral Sand-Verbena was found in sandy soil in the vicinity of the Sandia Creek and the SMR. This species was documented for the first time on Camp Pendleton during 2008, in an area of the floodplain of the SMR that may be impacted by the SMRCUP. It is reasonable to infer that the Camp Pendleton population was derived from the upstream populations within the OSMZ. Nine hundred twenty seven individuals of chaparral sand-verbena were documented during 2008 plant surveys (Figures 4-7). CNDDB forms for chaparral sand-verbena are included in Appendix B.

Fish's Milkwort (*Polygala cornuta* var. *fishiae*), a CNPS list 4.3 species, was found in coast live oak woodland south of the SMR (Figures 7-8, photo at left). Approximately 2,085 individuals were found. CNDDB forms for Fish's Milkwort are included in Appendix B.

Ocellated Humboldt lily (*Lilium humboldtii* var. *ocellatum*), a CNPS list 4.2 species, was found along the well used SMR trail in a coast live oak woodland (Figure 7, photo at right). Three individuals were observed in May and on the third survey on June 20, 2008 only two individuals were observed. This species is at risk of being collected. A CNDDB form for the ocellated Humboldt lily individuals is included in Appendix B.

Engelmann Oak (*Quercus engelmannii*), a CNPS list 4 species, was found along the north side of Sandia Creek road and at the top of a few small drainages near an avocado grove on the north side of the project area. Since Engelmann oak is relatively common in San Diego County and the CNDDB does not normally solicit information on list 4 species, no CNDDB form was prepared.

Interesting scrub oaks have been documented in the OSMZ. During 2008 plant surveys Torrey scrub oak (*Quercus Xacutidens*) was encountered. Tom Chester has documented two scrub oak hybrid species in the area including scrub oak x Engelmann oak and Torrey oak x Engelmann oak (Chester 2003).

San Miguel savory (*Satureja chandleri*), a CNPS list 1B.2, species was documented in 1983 seven miles south of Temecula along Sandia Creek (CDFG 2008). No San Miguel savory was encountered during 2008 plant surveys.

CONCLUSIONS

Although no federally or state-listed endangered plant species were detected, the OSMZ contains native scrub and woodland plant communities that are of high quality and support a high diversity of native plant species as indicated by the plant list in Appendix A. Two CNPS list 1B (considered rare and endangered) species were found in fairly large numbers at multiple sites, reinforcing the conservation value of the OSMZ. The preservation of apparent source populations of Chaparral Sand-Verbena upstream of Camp Pendleton on the OSMZ could conceivably help to mitigate impacts, if they cannot be avoided, of the SMRCUP on the Camp Pendleton population of this species.

REFERENCES

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FIGURES: ATTACHED

APPENDICES

Appendix A: Plant List
Appendix B: CNDDB FORMS

PHOTOGRAPHS

Compiled on accompanying DVD

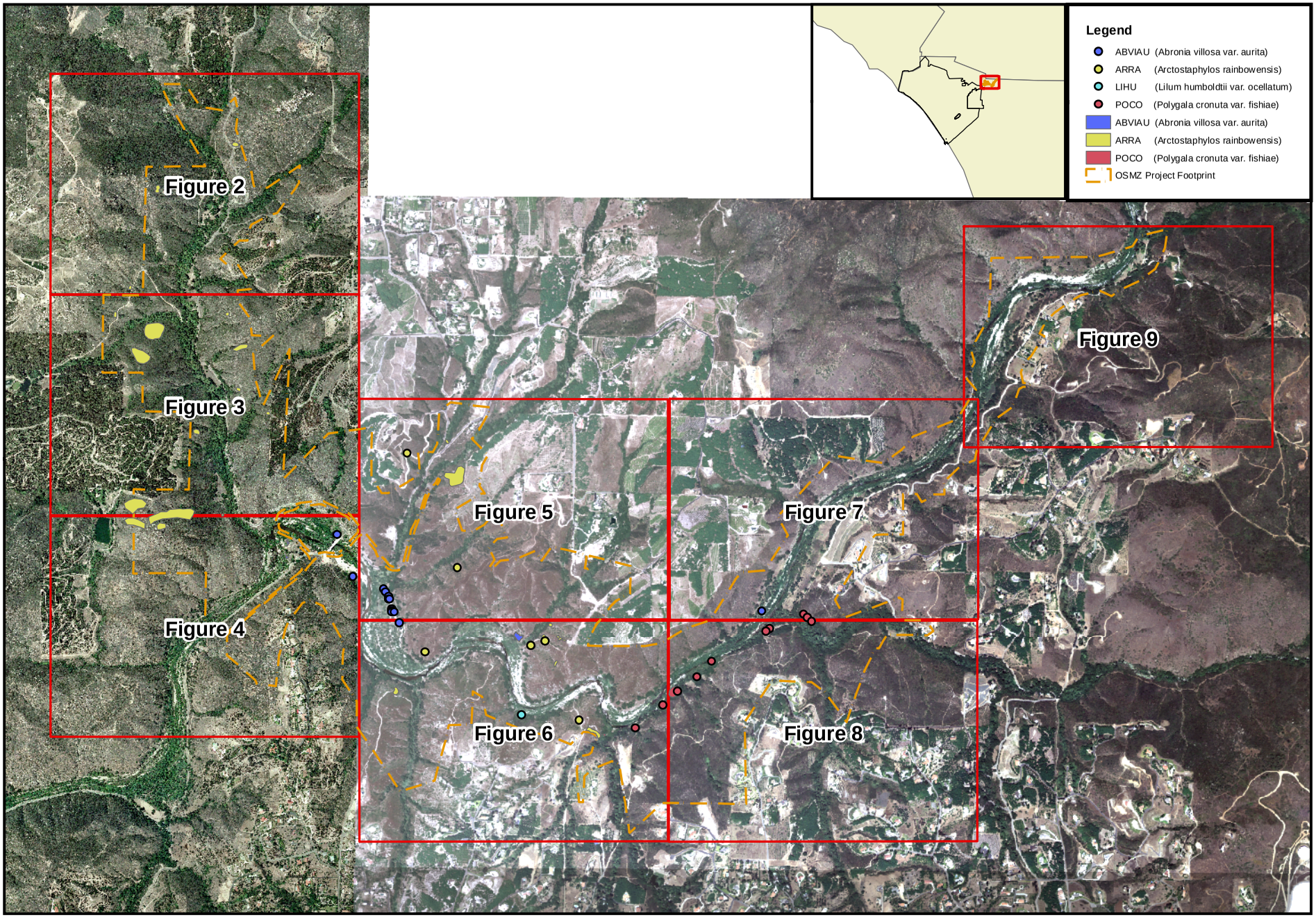

Figure 1. OSMZ Overview for Plant Survey

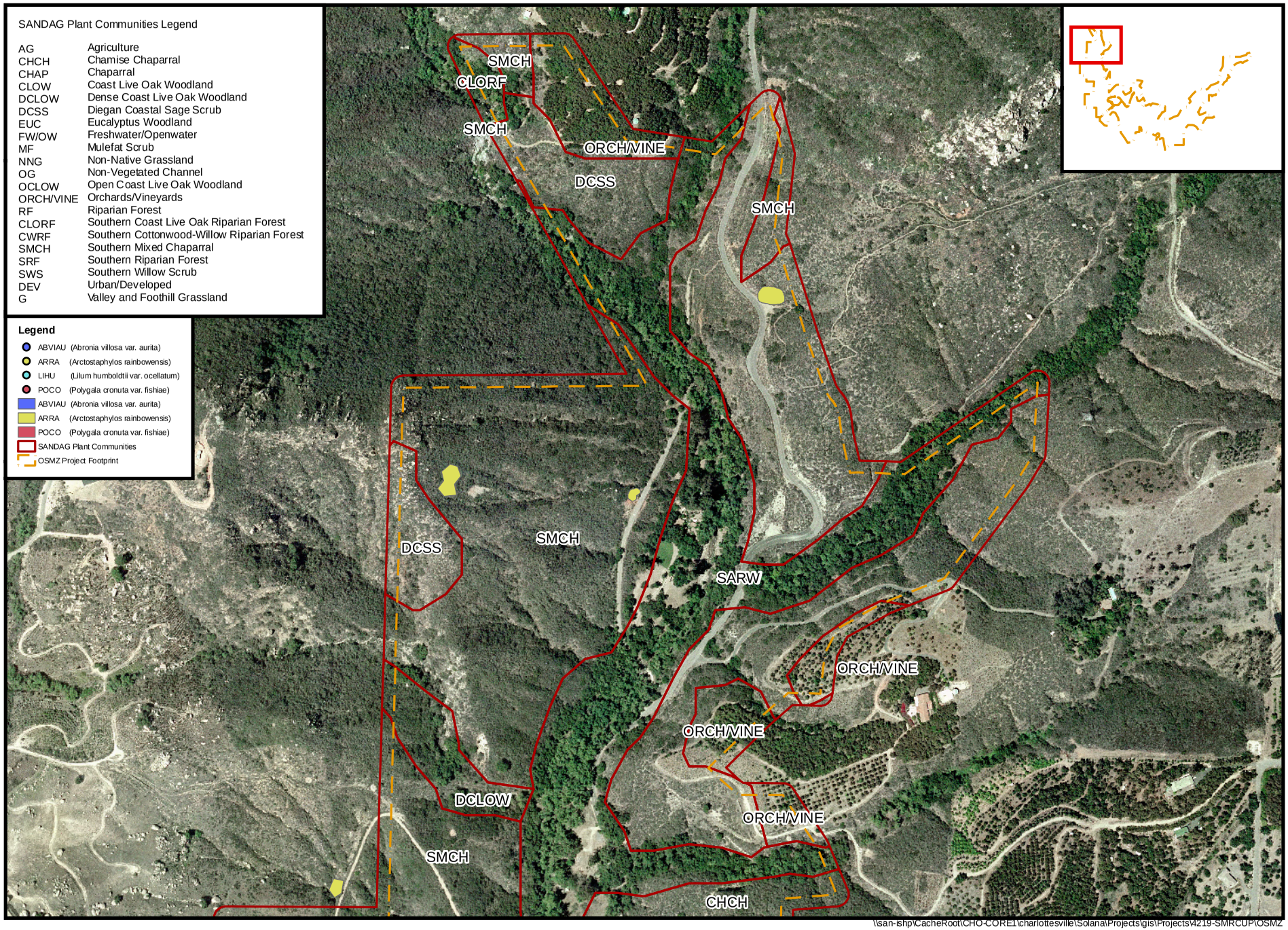

Figure 2. OSMZ Plant Survey

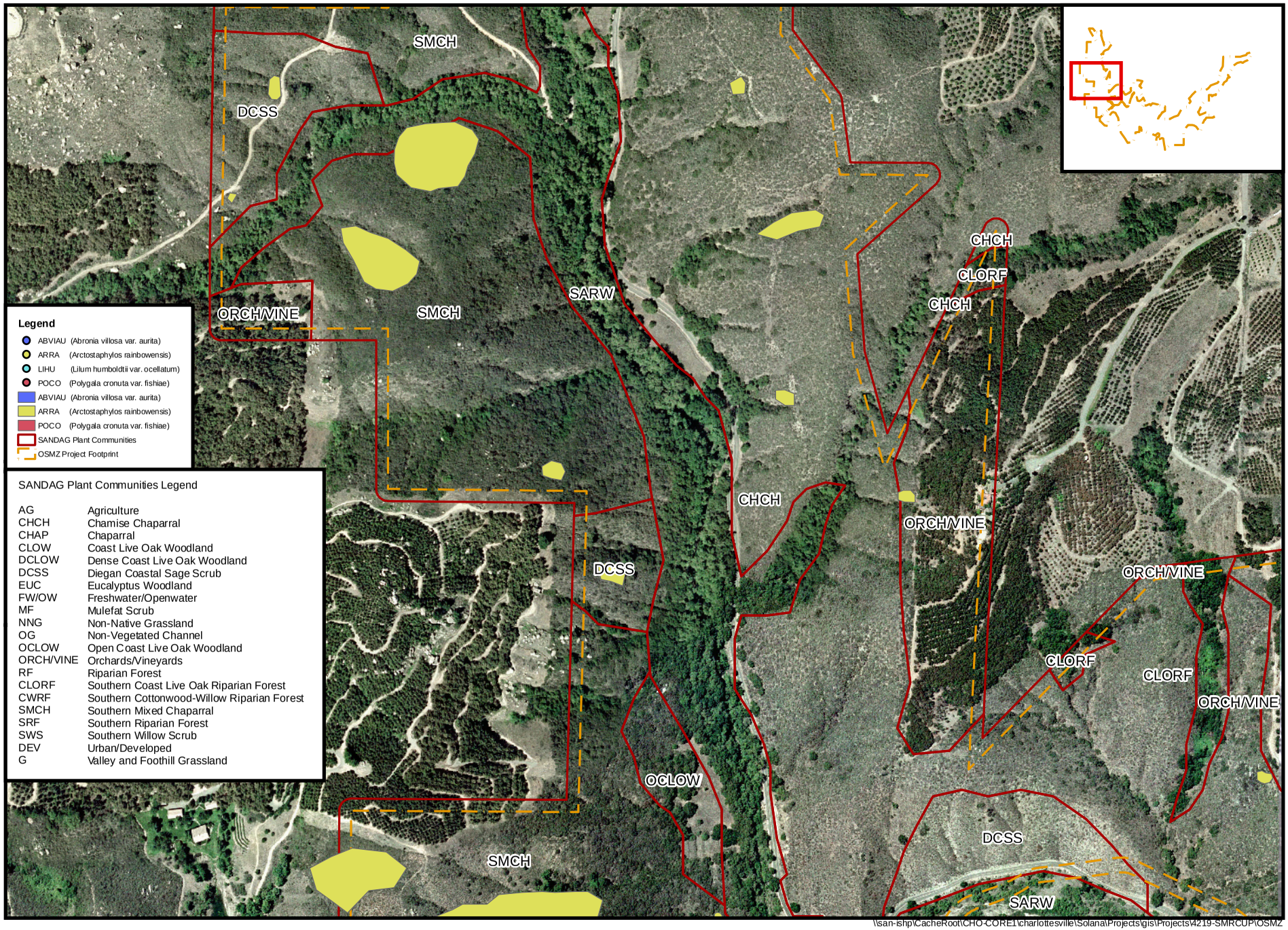

Figure 3. OSMZ Plant Survey

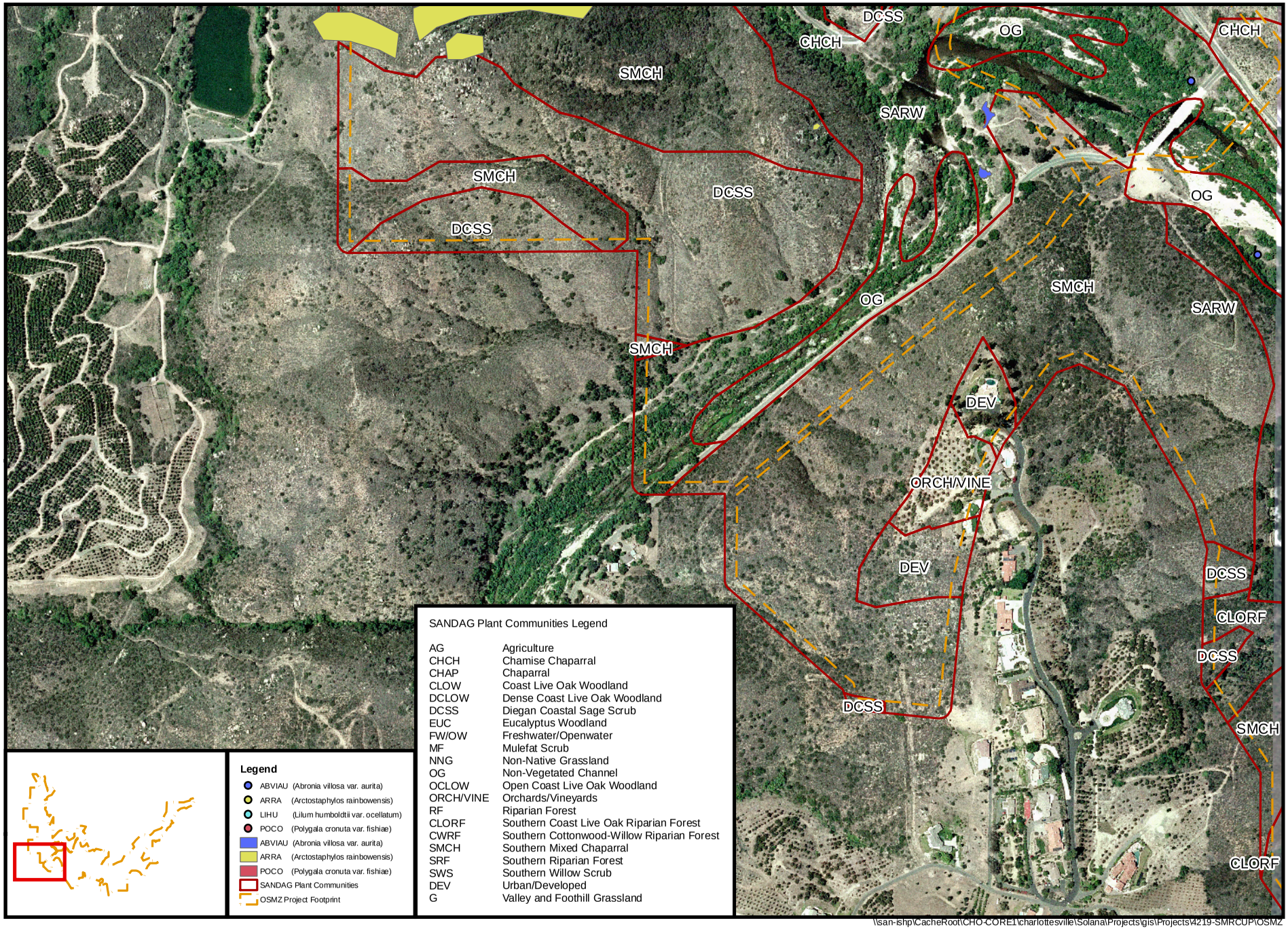

Figure 4. OSMZ Plant Survey

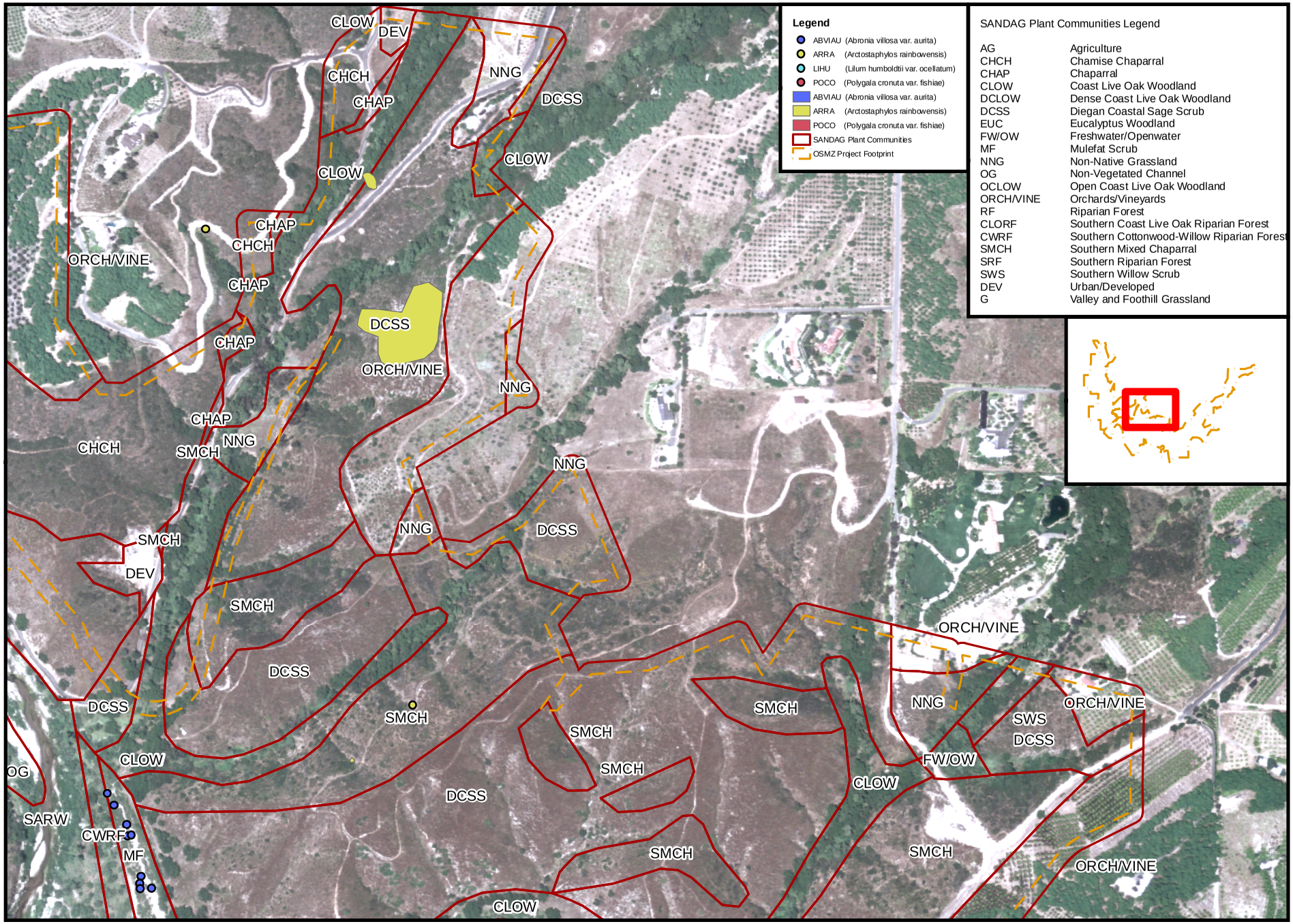

Figure 5. OSMZ Plant Survey

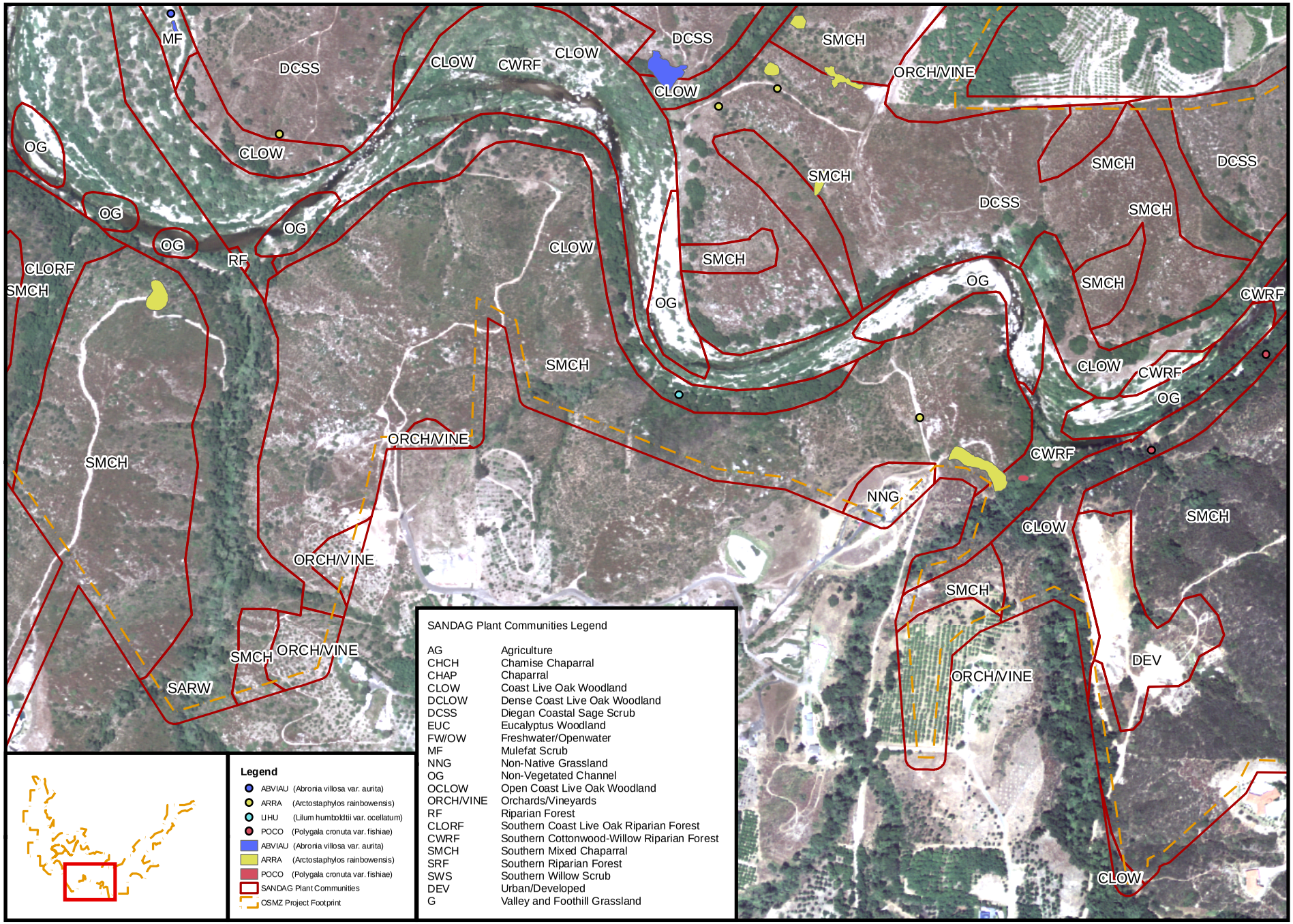

Figure 6. OSMZ Plant Survey

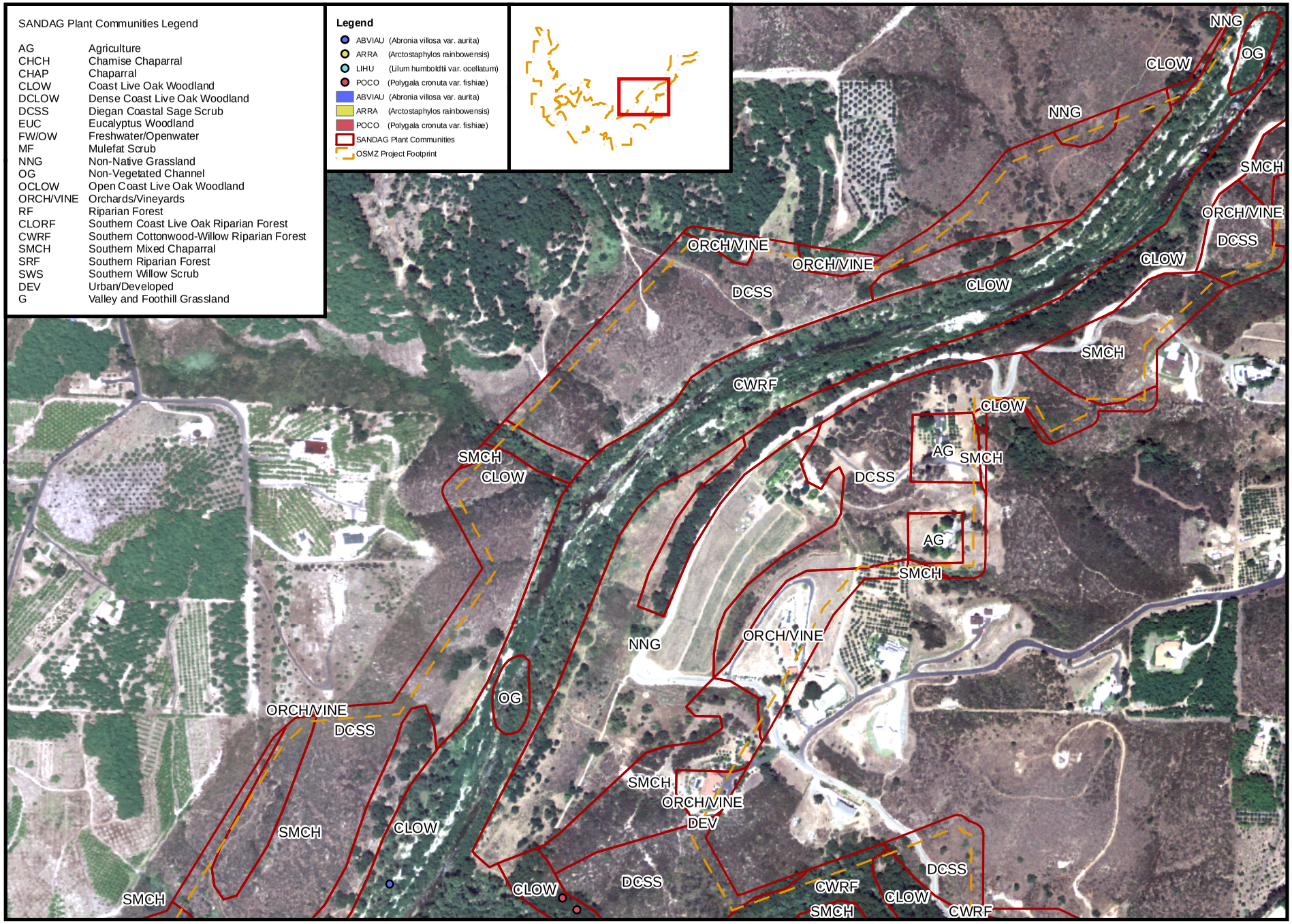

Figure 7. OSMZ Plant Survey

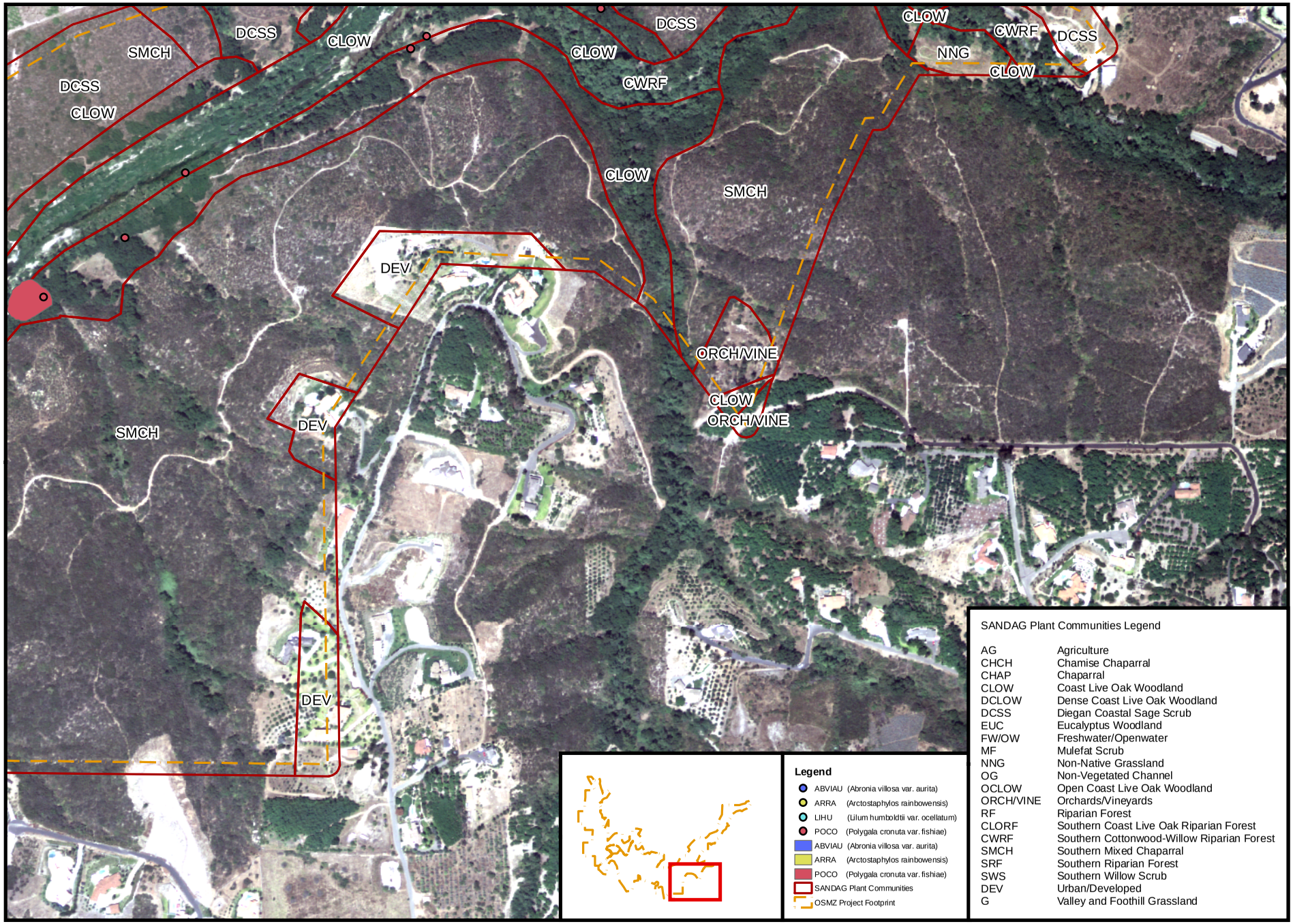

Figure 8. OSMZ Plant Survey

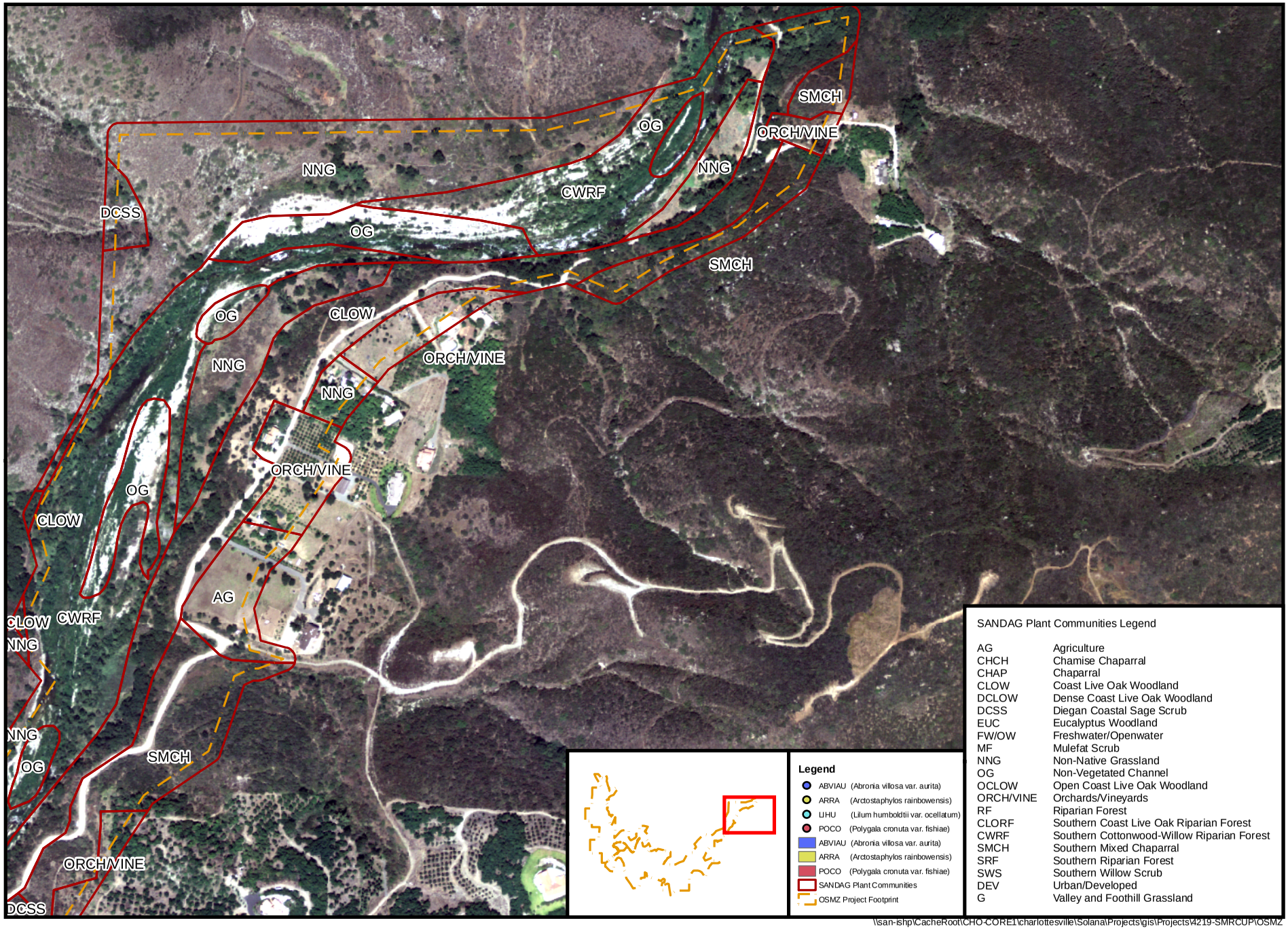

Figure 9. OSMZ Plant Survey

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SMRCUP OSMZ Plant List

CommonName	Family	Genus	Species	InfraName	Native
Blue Elderberry	Adoxaceae	*Sambucus*	*mexicana*		Yes
Century Plant	Agavaceae	*Agave*	*americana*		No
Chaparral Candle	Agavaceae	*Hesperoyucca*	*whipplei*		Yes
Iceplant	Aizoaceae	*Carpobrotus*	*edulis*		No
Spearscale	Amaranthaceae	*Atriplex*	*prostrata*		Yes
Berlandier's Pit-Seed Goosefoot	Amaranthaceae	*Chenopodium*	*berlandieri*		Yes
California Goosefoot	Amaranthaceae	*Chenopodium*	*californicum*		Yes
Mexican Tea	Amaranthaceae	*Dysphania*	*ambrosioides*		No
Prickly Russian-Thistle, Tumbleweed	Amaranthaceae	*Salsola*	*tragus*		No
Laurel Sumac	Anacardiaceae	*Malosma*	*laurina*		Yes
Sugar Bush	Anacardiaceae	*Rhus*	*ovata*		Yes
Skunkbrush	Anacardiaceae	*Rhus*	*trilobata*		Yes
Pepper Tree	Anacardiaceae	*Schinus*	*molle*		No
Western Poison-Oak	Anacardiaceae	*Toxicodendron*	*diversilobum*		Yes
Bur Chervil	Apiaceae	*Anthriscus*	*caucalis*		No
Mock-Parsley	Apiaceae	*Apiastrum*	*angustifolium*		Yes
Common Celery	Apiaceae	*Apium*	*graveolens*		No
Common Poison Hemlock	Apiaceae	*Conium*	*maculatum*		No
Rattlesnake Weed	Apiaceae	*Daucus*	*pusillus*		Yes
Whorled Marsh Pennywort	Apiaceae	*Hydrocotyle*	*verticillata*		Yes
Sharp-Tooth Sanicle	Apiaceae	*Sanicula*	*arguta*		Yes
Pacific Sanicle	Apiaceae	*Sanicula*	*crassicaulis*		Yes
Climbing Milkweed	Apocynaceae	*Sarcostemma*	*cynanchoides*	ssp. *hartwegii*	Yes
Greater Periwinkle	Apocynaceae	*Vinca*	*major*		No
Least Duckweed	Araceae	*Lemna*	*minuta*		Yes
Canary Island Date Palm	Arecaceae	*Phoenix*	*canariensis*		No
Mexican fan palm	Arecaceae	*Washingtonia*	*robusta*		No
Scapellote	Asteraceae	*Acourtia*	*microcephala*		Yes
Annual Bur-Sage	Asteraceae	*Ambrosia*	*acanthicarpa*		Yes
Western Ragweed	Asteraceae	*Ambrosia*	*psilostachya*		Yes
Coastal Sagebrush	Asteraceae	*Artemisia*	*californica*		Yes
Douglas Mugwort	Asteraceae	*Artemisia*	*douglasiana*		Yes
Emory's Baccharis	Asteraceae	*Baccharis*	*emoryi*		Yes
Coyote Bush	Asteraceae	*Baccharis*	*pilularis*		Yes
Mule-Fat, Seep-Willow	Asteraceae	*Baccharis*	*salicifolia*		Yes
Rush Sweetbush	Asteraceae	*Bebbia*	*juncea*	var. *aspera*	Yes
California Brickellbush	Asteraceae	*Brickellia*	*californica*		Yes
Italian Thistle	Asteraceae	*Carduus*	*pycnocephalus*		No
Yellow Star-Thistle	Asteraceae	*Centaurea*	*solstitialis*		No
White Pincushion	Asteraceae	*Chaenactis*	*artemisiifolia*		Yes
Yellow Pincushion	Asteraceae	*Chaenactis*	*glabriuscula*	var. *glabriuscula*	Yes
Bull Thistle	Asteraceae	*Cirsium*	*vulgare*		No
Blessed Thistle	Asteraceae	*Cnicus*	*benedictus*		No
Common Sand-Aster	Asteraceae	*Corethrogyne*	*filaginifolia*	var. *filaginifolia*	Yes
Fascicled Tarweed	Asteraceae	*Deinandra*	*fasciculata*		Yes
Blue-Eye Cape-Marigold	Asteraceae	*Dimorphotheca*	*sinuata*		No
Boundary Goldenbush	Asteraceae	*Ericameria*	*brachylepis*		Yes
Leafy Daisy	Asteraceae	*Erigeron*	*foliosus*	var. *foliosus*	Yes
Long-Stem Golden-Yarrow	Asteraceae	*Eriophyllum*	*confertiflorum*	var. *confertiflorum*	Yes
Western Goldenrod	Asteraceae	*Euthamia*	*occidentalis*		Yes
Southern Sawtooth Goldenbush	Asteraceae	*Hazardia*	*squarrosa*	var. *grindelioides*	Yes
Crete Hedypnois	Asteraceae	*Hedypnois*	*cretica*		No
Western Sunflower	Asteraceae	*Helianthus*	*annuus*		Yes
Telegraph Weed	Asteraceae	*Heterotheca*	*grandiflora*		Yes
Smooth Cat's Ear	Asteraceae	*Hypochaeris*	*glabra*		No
Prickly Lettuce	Asteraceae	*Lactuca*	*serriola*		No
Southern Goldfields	Asteraceae	*Lasthenia*	*coronaria*		Yes
Tidy Tips	Asteraceae	*Layia*	*platyglossa*		Yes
Scale-Broom	Asteraceae	*Lepidospartum*	*squamatum*		Yes
Cud Aster	Asteraceae	*Lessingia*	*filaginifolia*	var. *filaginifolia*	Yes
Narrow-Leaf Filago	Asteraceae	*Logfia*	*gallica*		Yes
Osmadenia	Asteraceae	*Osmadenia*	*tenella*		Yes
Salt Marsh Fleabane	Asteraceae	*Pluchea*	*odorata*		Yes
Arrow Weed	Asteraceae	*Pluchea*	*sericea*		Yes
Odora	Asteraceae	*Porophyllum*	*gracile*		Yes
Fragrant Everlasting	Asteraceae	*Pseudognaphalium*	*beneolens*		Yes
Fragrant Cudweed	Asteraceae	*Pseudognaphalium*	*luteo-album*		No
White Everlasting	Asteraceae	*Pseudognaphalium*	*microcephalum*		Yes
Cotton-Batting Plant	Asteraceae	*Pseudognaphalium*	*stramineum*		Yes
Common Groundsel	Asteraceae	*Senecio*	*vulgaris*		No
Prickly Sow-Thistle	Asteraceae	*Sonchus*	*asper*	ssp. *asper*	No
Common Sow-Thistle	Asteraceae	*Sonchus*	*oleraceus*		No

SMRCUP OSMZ Plant List

CommonName	Family	Genus	Species	InfraName	Native
Deane's Small Wreath-Plant	Asteraceae	*Stephanomeria*	*exigua*	ssp. *deanei*	Yes
Silver Puffs	Asteraceae	*Uropappus*	*lindleyi*		Yes
Cocklebur	Asteraceae	*Xanthium*	*strumarium*		Yes
Alder	Betulaceae	*Alnus*	*rhombifolia*		Yes
Catalpa	Bignoniaceae	*Catalpa*	*spp.*		No
Cryptantha	Boraginaceae	*Cryptantha*	*clevelandii*	var. *florosa*	Yes
Cryptantha	Boraginaceae	*Cryptantha*	*clevelandii*	var. *clevelandii*	Yes
Nievitas Cryptantha	Boraginaceae	*Cryptantha*	*intermedia*		Yes
Prickly Cryptantha	Boraginaceae	*Cryptantha*	*muricata*		Yes
Slender Pectocarya	Boraginaceae	*Pectocarya*	*linearis*	ssp. f*erocula*	Yes
California Popcornflower	Boraginaceae	*Plagiobothrys*	*collinus*	var. *californicus*	Yes
Black Mustard	Brassicaceae	*Brassica*	*nigra*		No
Lesser Wart-Cress	Brassicaceae	*Coronopus*	*didymus*		No
Short-Pod Mustard	Brassicaceae	*Hirschfeldia*	*incana*		No
Wild Radish	Brassicaceae	*Raphanus*	*sativus*		No
Water-Cress	Brassicaceae	*Rorippa*	*nasturtium-aquaticum*		No
London Rocket	Brassicaceae	*Sisymbrium*	*irio*		No
Hare's-Ear Cabbage	Brassicaceae	*Sisymbrium*	*orientale*		No
Mesa Prickly Pear	Cactaceae	*Opuntia*	*xvaseyi*		Yes
Desert Prickly Pear	Cactaceae	*Opuntia*	*phaecantha*		Yes
Notch Fringepod	Brassicaceae	*Thysanocarpus*	*laciniatus*		Yes
Johnston's Honeysuckle	Caprifoliaceae	*Lonicera*	*subspicata*	var. *denudata*	Yes
Mouse-Ear Chickweed	Caryophyllaceae	*Cerastium*	*glomeratum*		No
Snapdragon Catchfly	Caryophyllaceae	*Silene*	*antirrhina*		Yes
Common Catchfly	Caryophyllaceae	*Silene*	*gallica*		No
Southern Pink	Caryophyllaceae	*Silene*	*laciniata*	ssp. *laciniata*	Yes
Common Chickweed	Caryophyllaceae	*Stellaria*	*media*		No
Peak Rush-Rose	Cistaceae	*Helianthemum*	*scoparium*		Yes
Southern California Morning-Glory	Convolvulaceae	*Calystegia*	*macrostegia*	ssp. *arida*	Yes
Chaparral Dodder	Convolvulaceae	*Cuscuta*	*californica*	var. *californica*	Yes
Dodder	Convolvulaceae	*Cuscuta*	*campestris*		Yes
Ladies' Fingers	Crassulaceae	*Dudleya*	*edulis*		Yes
Chalk Dudleya	Crassulaceae	*Dudleya*	*pulverulenta*		Yes
Calabazilla	Cucurbitaceae	*Cucurbita*	*foetidissima*		Yes
Manroot, Wild-Cucumber	Cucurbitaceae	*Marah*	*macrocarpus*	var. *macrocarpus*	Yes
Barbara's Sedge	Cyperaceae	*Carex*	*barbarae*		Yes
San Diego Sedge	Cyperaceae	*Carex*	*spissa*		Yes
Triangular-Fruit Sedge	Cyperaceae	*Carex*	*triquetra*		Yes
Tall Flatsedge	Cyperaceae	*Cyperus*	*eragrostis*		Yes
African Umbrella Plant	Cyperaceae	*Cyperus*	*involucratus*		No
Brown Umbrella-Sedge	Cyperaceae	*Cyperus*	*niger*		Yes
Fragrant Flatsedge	Cyperaceae	*Cyperus*	*odoratus*		Yes
Dombey's Spike-Rush	Cyperaceae	*Eleocharis*	*montevidensis*		Yes
Viscid Bulrush	Cyperaceae	*Schoenoplectus*	*acutus*	var. *occidentalis*	Yes
Olney's Bulrush	Cyperaceae	*Schoenoplectus*	*americanus*		Yes
Small-Fruit Bulrush	Cyperaceae	*Scirpus*	*microcarpus*		Yes
Durango Root	Datiscaceae	*Datisca*	*glomerata*		Yes
Western Bracken	Dennstaedtiaceae	*Pteridium*	*aquilinum*	var. *pubescens*	Yes
Coastal Wood Fern	Dryopteridaceae	*Dryopteris*	*arguta*		Yes
Common Horsetail	Equisetaceae	*Equisetum*	*arvense*		Yes
Common Scouring-Rush	Equisetaceae	*Equisetum*	*hyemale*	ssp. *affine*	Yes
Smooth Scouring-Rush	Equisetaceae	*Equisetum*	*laevigatum*		Yes
Rainbow Manzanita	Ericaceae	*Arctostaphylos*	*rainbowensis*		Yes
Mission Manzanita	Ericaceae	*Xylococcus*	*bicolor*		Yes
Small-Seed Sandmat	Euphorbiaceae	*Chamaesyce*	*polycarpa*		Yes
California Croton	Euphorbiaceae	*Croton*	*californicus*		Yes
Doveweed	Euphorbiaceae	*Croton*	*setigerus*		Yes
Chinese Caps	Euphorbiaceae	*Euphorbia*	*crenulata*		Yes
Petty Spurge	Euphorbiaceae	*Euphorbia*	*peplus*		No
Castor Bean	Euphorbiaceae	*Ricinus*	*communis*		No
Cootamundra Wattle	Fabaceae	*Acacia*	*baileyana*		No
False Indigo	Fabaceae	*Amorpha*	*fruticosa*		Yes
Leather Root	Fabaceae	*Hoita*	*macrostachya*		Yes
San Diego Sweet Pea	Fabaceae	*Lathyrus*	*vestitus*	var. *alefeldii*	Yes
Grab Lotus	Fabaceae	*Lotus*	*hamatus*		Yes
Heermann's Lotus	Fabaceae	*Lotus*	*heermannii*	var. *heermannii*	Yes
Alkali Lotus	Fabaceae	*Lotus*	*salsuginosus*	var. *salsuginosus*	Yes
Short-Wing Deerweed	Fabaceae	*Lotus*	*scoparius*	var. *brevialatus*	Yes
Bishop's/Strigose Lotus	Fabaceae	*Lotus*	*strigosus*		Yes
Miniature Lupine	Fabaceae	*Lupinus*	*bicolor*		Yes
Hall's Bush Lupine	Fabaceae	*Lupinus*	*excubitus*	var. *hallii*	Yes
Stinging Lupine	Fabaceae	*Lupinus*	*hirsutissimus*		Yes

SMRCUP OSMZ Plant List

CommonName	Family	Genus	Species	InfraName	Native
Arroyo Lupine	Fabaceae	*Lupinus*	*succulentus*		Yes
Collar Lupine	Fabaceae	*Lupinus*	*truncatus*		Yes
California Burclover	Fabaceae	*Medicago*	*polymorpha*		No
White Sweetclover	Fabaceae	*Melilotus*	*albus*		No
Indian Sweetclover	Fabaceae	*Melilotus*	*indicus*		No
Honey Mesquite	Fabaceae	*Prosopis*	*glandulosa*	var. *torreyana*	Yes
Tree Clover	Fabaceae	*Trifolium*	*ciliolatum*		Yes
Rose Clover	Fabaceae	*Trifolium*	*hirtum*		No
Valley Clover	Fabaceae	*Trifolium*	*willdenovii*		Yes
Winter Vetch	Fabaceae	*Vicia*	*villosa*	ssp. *villosa*	No
Coast Live Oak, Encina	Fagaceae	*Quercus*	*agrifolia*	var. *agrifolia*	Yes
Engelmann's/Mesa Blue Oak	Fagaceae	*Quercus*	*engelmannii*		Yes
Torrey's Scrub Oak	Fagaceae	*Quercus*	X *acutidens*		Yes
Canchalagua	Gentianaceae	*Centaurium*	*venustum*		Yes
Alkali Chalice	Gentianaceae	*Eustoma*	*exaltatum*		Yes
Long-Beak Filaree/Storksbill	Geraniaceae	*Erodium*	*botrys*		No
Red-Stem Filaree/Storksbill	Geraniaceae	*Erodium*	*cicutarium*		No
Cut-Leaf Geranium	Geraniaceae	*Geranium*	*dissectum*		No
White-Flower Currant	Grossulariaceae	*Ribes*	*indecorum*		Yes
Salt Heliotrope	Heliotropaceae	*Heliotropium*	*curassavicum*		Yes
Small-Flower Soap Plant	Hyacinthaceae	*Chloragalum*	*parviflorum*		Yes
Whispering Bells	Hydrophyllaceae	*Emmenanthe*	*penduliflora*	var. *penduliflora*	Yes
Common Eucrypta	Hydrophyllaceae	*Eucrypta*	*chrysanthemifolia*	var. *chrysanthemifolia*	Yes
Small-Flower Baby Blue Eyes	Hydrophyllaceae	*Nemophila*	*menziesii*	var. *integrifolia*	Yes
Caterpillar Phacelia	Hydrophyllaceae	*Phacelia*	*cicutaria*	var. *hispida*	Yes
Wild Canterbury-Bell	Hydrophyllaceae	*Phacelia*	*minor*		Yes
Phacelia	Hydrophyllaceae	*Phacelia*	*minor x P. parryi*		Yes
Branching Phacelia	Hydrophyllaceae	*Phacelia*	*ramosissima*	var. *latifolia*	Yes
Fiesta Flower	Hydrophyllaceae	*Pholistoma*	*auritum*	var. *auritum*	Yes
Blue-Eyed-Grass	Iridaceae	*Sisyrinchium*	*bellum*		Yes
Pecan	Juglandaceae	*Carya*	*illinoinensis*		No
Southern California Black Walnut	Juglandaceae	*Juglans*	*californica*	var. *californica*	Yes
Iris-Leaf Rush	Juncaceae	*Juncus*	*xiphioides*		Yes
Henbit	Lamiaceae	*Lamium*	*amplexicaule*		No
Horehound	Lamiaceae	*Marrubium*	*vulgare*		No
Mint	Lamiaceae	*Mentha*	*spp.*		No
White Sage	Lamiaceae	*Salvia*	*apiana*		Yes
Chia	Lamiaceae	*Salvia*	*columbariae*		Yes
Black Sage	Lamiaceae	*Salvia*	*mellifera*		Yes
Woolly Bluecurls	Lamiaceae	*Trichostema*	*lanatum*		Yes
Splendid Mariposa Lily	Liliaceae	*Calochortus*	*splendens*		Yes
Chaparral Bushmallow	Malvaceae	*Malacothamnus*	*fasciculatus*		Yes
Cheeseweed	Malvaceae	*Malva*	*parviflora*		No
Eucalyptus	Myrtaceae	*Eucalyptus*	*spp.*		No
Chaparral Sand-Verbena	Nyctaginaceae	*Abronia*	*villosa*	var. *aurita*	Yes
Coastal Wishbone Plant	Nyctaginaceae	*Mirabilis*	*laevis*	var. *crassifolia*	Yes
Olive	Oleaceae	*Olea*	*europaea*		No
California Sun Cup	Onagraceae	*Camissonia*	*bistorta*		Yes
False-Mustard	Onagraceae	*Camissonia*	*californica*		Yes
Canyon Godetia	Onagraceae	*Clarkia*	*epilobioides*		Yes
Four-Spot Clarkia	Onagraceae	*Clarkia*	*purpurea*	ssp. *quadrivulnera*	Yes
Canyon Clarkia	Onagraceae	*Clarkia*	*similis*		Yes
California Fuchsia	Onagraceae	*Epilobium*	*canum*	ssp. *canum*	Yes
Willow Herb	Onagraceae	*Epilobium*	*ciliatum*	ssp. *ciliatum*	Yes
Drummond's Gaura	Onagraceae	*Gaura*	*drummondii*		No
California Evening-Primrose	Onagraceae	*Oenothera*	*californica*		Yes
Great Marsh Evening-Primrose	Onagraceae	*Oenothera*	*elata*	ssp. *hirsutissima*	Yes
Purple Owl's-Clover	Orobanchaceae	*Castilleja*	*exserta*	ssp. *exserta*	Yes
Dark-Tip Bird's Beak	Orobanchaceae	*Cordylanthus*	*rigidus*	ssp. *setigerus*	Yes
California Wood-Sorrel	Oxalidaceae	*Oxalis*	*albicans*	ssp. *californica*	Yes
Bermuda-Buttercup	Oxalidaceae	*Oxalis*	*pes-caprae*		No
California Peony	Paeoniaceae	*Paeonia*	*californica*		Yes
Golden Ear-Drops	Papaveraceae	*Dicentra*	*chrysantha*		Yes
California Poppy	Papaveraceae	*Eschscholzia*	*californica*		Yes
Fire Poppy	Papaveraceae	*Papaver*	*californicum*		Yes
Cream Cups	Papaveraceae	*Platystemon*	*californicus*		Yes
Coast Monkey Flower	Phrymaceae	*Mimulus*	*aurantiacus*	var. *puniceus*	Yes
Slope Semiphore	Phrymaceae	*Mimulus*	*brevipes*		Yes
Scarlet Monkey Flower	Phrymaceae	*Mimulus*	*cardinalis*		Yes
Seep Monkey Flower	Phrymaceae	*Mimulus*	*guttatus*		Yes
Climbing Snapdragon	Plantaginaceae	*Antirrhinum*	*kelloggii*		Yes
Nuttall's Snapdragon	Plantaginaceae	*Antirrhinum*	*nuttallianum*	ssp. *nuttallianum*	Yes

SMRCUP OSMZ Plant List

CommonName	Family	Genus	Species	InfraName	Native
Chinese Houses	Plantaginaceae	*Collinsia*	*heterophylla*		Yes
Yellow Bush Penstemon	Plantaginaceae	*Keckiella*	*antirrhinoides*	var. *antirrhinoides*	Yes
Climbing Bush Penstemon	Plantaginaceae	*Keckiella*	*cordifolia*		Yes
Large Blue Toadflax	Plantaginaceae	*Linaria*	*canadensis*		Yes
Showy Penstemon	Plantaginaceae	*Penstemon*	*spectabilis*	var. *spectabilis*	Yes
Dot-Seed Plantain	Plantaginaceae	*Plantago*	*erecta*		Yes
English Plantain	Plantaginaceae	*Plantago*	*lanceolata*		No
Common Plantain	Plantaginaceae	*Plantago*	*major*		No
Water Speedwell	Plantaginaceae	*Veronica*	*anagallis-aquatica*		No
Western Sycamore	Platanaceae	*Platanus*	*racemosa*		Yes
Notch-Leaf Marsh-Rosemary	Plumbaginaceae	*Limonium*	*sinuatum*		No
Giant Stipa	Poaceae	*Achnatherum*	*coronatum*		Yes
Water Beardgrass	Poaceae	*Agrostis*	*viridis*		No
Giant Reed	Poaceae	*Arundo*	*donax*		No
Slender Wild Oat	Poaceae	*Avena*	*barbata*		No
Wild Oat	Poaceae	*Avena*	*fatua*		No
Ripgut Grass	Poaceae	*Bromus*	*diandrus*		No
Foxtail Chess, Red Brome	Poaceae	*Bromus*	*madritensis*	ssp. *rubens*	No
Pampas Grass	Poaceae	*Cortaderia*	*selloana*		No
Bermuda Grass	Poaceae	*Cynodon*	*dactylon*		No
Common Barnyard Grass	Poaceae	*Echinochloa*	*crus-galli*		No
Panic Veldt Grass	Poaceae	*Ehrharta*	*erecta*		No
Long-Flower Veldt Grass	Poaceae	*Ehrharta*	*longiflora*		No
Jepson's Blue Wildrye	Poaceae	*Elymus*	*glaucus*	ssp. *jepsonii*	Yes
Nit Grass	Poaceae	*Gastridium*	*ventricosum*		No
Glaucous Barley	Poaceae	*Hordeum*	*murinum*	ssp. *glaucum*	No
Golden-Top	Poaceae	*Lamarckia*	*aurea*		No
Mexican Sprangletop	Poaceae	*Leptochloa*	*fusca*	ssp. *uninervia*	Yes
Giant Wild-Rye	Poaceae	*Leymus*	*condensatus*		Yes
Beardless Wild-Rye	Poaceae	*Leymus*	*triticoides*		Yes
Coast Range Melic	Poaceae	*Melica*	*imperfecta*		Yes
Natal Grass	Poaceae	*Melinis*	*repens*	ssp. *repens*	No
Little-Seed Muhly	Poaceae	*Muhlenbergia*	*microsperma*		Yes
Foothill Needlegrass	Poaceae	*Nassella*	*lepida*		Yes
Purple Needlegrass	Poaceae	*Nassella*	*pulchra*		Yes
Common Knotgrass	Poaceae	*Paspalum*	*distichum*		Yes
African Fountain Grass	Poaceae	*Pennisetum*	*setaceum*		No
Smilo Grass	Poaceae	*Piptatherum*	*miliaceum*		No
Annual Beard Grass	Poaceae	*Polypogon*	*monspeliensis*		No
Mediterranean Schismus	Poaceae	*Schismus*	*barbatus*		No
Hairy Rat-Tail Fescue	Poaceae	*Vulpia*	*myuros*	var. *hirsuta*	No
Blue False-Gilia	Polemoniaceae	*Allophyllum*	*glutinosum*		Yes
Many-Flower Woolly-Star	Polemoniaceae	*Eriastrum*	*sapphirinum*	ssp. dasyanthum	Yes
Grassland Gilia	Polemoniaceae	*Gilia*	*angelensis*		Yes
Ball Gilia	Polemoniaceae	*Gilia*	*capitata*	ssp. *abrotanifolia*	Yes
Coast Baby-Star	Polemoniaceae	*Leptosiphon*	*parviflorus*		Yes
Fish's Milkwort	Polygalaceae	*Polygala*	*cornuta*	var. *fishiae*	Yes
Fringed Spineflower	Polygonaceae	*Chorizanthe*	*fimbriata*	var. *fimbriata*	Yes
Prostrate Spineflower	Polygonaceae	*Chorizanthe*	*procumbens*		Yes
Tall Buckwheat	Polygonaceae	*Eriogonum*	*elongatum*	var. *elongatum*	Yes
Inland California Buckwheat	Polygonaceae	*Eriogonum*	*fasciculatum*	var. *foliolosum*	Yes
Slender Buckwheat	Polygonaceae	*Eriogonum*	*gracile*		Yes
Willow Smartweed, Willow Weed	Polygonaceae	*Polygonum*	*lapathifolium*		Yes
Granny's Hairnet, G. C. P.	Polygonaceae	*Pterostegia*	*drymarioides*		Yes
Desert Rhubarb	Polygonaceae	*Rumex*	*hymenosepalus*		Yes
California Polypody	Polypodiaceae	*Polypodium*	*californicum*		Yes
Red Maids	Portulacaceae	*Calandrinia*	*ciliata*		Yes
Common Calyptridium	Portulacaceae	*Calyptridium*	*monandrum*		Yes
Mexican Miner's-Lettuce	Portulacaceae	*Claytonia*	*perfoliata*	ssp. *mexicana*	Yes
Scarlet Pimpernel	Primulaceae	*Anagallis*	*arvensis*		No
Padre's Shooting Star	Primulaceae	*Dodecatheon*	*clevelandii*	ssp. *clevelandii*	Yes
Maidenhair Fern	Pteridaceae	*Adiantum*	*capillus-veneris*		Yes
California Cotton Fern	Pteridaceae	*Cheilanthes*	*newberryi*		Yes
Coffee Fern	Pteridaceae	*Pellaea*	*andromedifolia*		Yes
Bird's Foot Cliff-Brake	Pteridaceae	*Pellaea*	*mucronata*	var. *mucronata*	Yes
Ropevine Clematis	Ranunculaceae	*Clematis*	*pauciflora*		Yes
Parry's Larkspur	Ranunculaceae	*Delphinium*	*parryi*	ssp. *parryi*	Yes
Smooth-Leaf Meadow-Rue	Ranunculaceae	*Thalictrum*	*fendleri*	var. *polycarpum*	Yes
Thick-Leaf-Lilac	Rhamnaceae	*Ceanothus*	*crassifolius*		Yes
Ramona-Lilac	Rhamnaceae	*Ceanothus*	*tomentosus*		Yes
Holly-Leaf Redberry	Rhamnaceae	*Rhamnus*	*ilicifolia*		Yes
Chamise	Rosaceae	*Adenostoma*	*fasciculatum*		Yes

SMRCUP OSMZ Plant List

CommonName	Family	Genus	Species	InfraName	Native
San Diego Mountain-Mahogany	Rosaceae	*Cercocarpus*	*minutiflorus*		Yes
Toyon, Christmas Berry	Rosaceae	*Heteromeles*	*arbutifolia*		Yes
Islay, Holly-Leaf Cherry	Rosaceae	*Prunus*	*ilicifolia*	ssp. *ilicifolia*	Yes
California Blackberry	Rosaceae	*Rubus*	*ursinus*		Yes
California Rose	Rosaceae	*Rosa*	*californica*		Yes
Narrow-Leaf Bedstraw	Rubiaceae	*Galium*	*angustifolium*	ssp. *angustifolium*	Yes
Common Bedstraw, Goose Grass	Rubiaceae	*Galium*	*aparine*		No
Western Cottonwood	Salicaceae	*Populus*	*fremontii*	ssp. *fremontii*	Yes
Narrow-Leaf Willow	Salicaceae	*Salix*	*exigua*		Yes
Black Willow	Salicaceae	*Salix*	*goodingii*		Yes
Red Willow	Salicaceae	*Salix*	*laevigata*		Yes
Arroyo Willow	Salicaceae	*Salix*	*lasiolepis*		Yes
Yerba Mansa	Saururaceae	*Anemopsis*	*californica*		Yes
Coast Jepsonia	Saxifragaceae	*Jepsonia*	*parryi*		Yes
Hill Star	Saxifragaceae	*Lithophragma*	*heterophyllum*		Yes
Scarlet Monkey Flower	Scrophulariaceae	*Mimulus*	*cardinalis*		Yes
Downy Monkey Flower	Scrophulariaceae	*Mimulus*	*pilosus*		Yes
Bigelow's Spike-Moss	Selaginellaceae	*Selaginella*	*bigelovii*		Yes
Western Jimson Weed	Solanaceae	*Datura*	*wrightii*		Yes
Tree Tobacco	Solanaceae	*Nicotiana*	*glauca*		No
Indian Tobacco	Solanaceae	*Nicotiana*	*quadrivalvis*		Yes
White Nightshade	Solanaceae	*Solanum*	*americanum*		Yes
Douglas's Nightshade	Solanaceae	*Solanum*	*douglasii*		Yes
Parish's Nightshade	Solanaceae	*Solanum*	*parishii*		Yes
Blue Dicks	Themidaceae	*Dichelostemma*	*capitatum*	ssp. *capitatum*	Yes
Broad-Leaf Cattail	Typhaceae	*Typha*	*latifolia*		Yes
Chinese Elm	Ulmaceae	*Ulmus*	*parvifolia*		Yes
California Pellitory	Urticaceae	*Parietaria*	*hespera*	var. *californica*	Yes
Hoary Nettle	Urticaceae	*Urtica*	*dioica*		Yes
Southern California Wild Grape	Vitaceae	*Vitis*	*girdiana*		Yes

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FINAL

Wildlife Survey Report
Santa Margarita River Conjunctive Use Project
Open Space Management Zone
Fallbrook Public Utility District, California

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Introduction

This report documents the results of a general wildlife survey of a proposed 1,384-acre Open Space Management Zone (OSMZ) in Fallbrook, San Diego County, California (Figure 1). The survey was completed between June 17 and July 19, 2008. The designation of the OSMZ is proposed as part of the Santa Margarita River Conjunctive Use Project (CUP) currently under review by the U.S. Bureau of Reclamation, Marine Corps Base Camp Pendleton, and the Fallbrook Public Utility District (FPUD). The OSMZ is owned by the FPUD and is at the site of the formerly proposed Fallbrook Dam and Reservoir. The OSMZ would be included in the CUP to help protect water quality and allow for passive recreation use. Mitigation, if required for other elements of the CUP, could also be incorporated into the OSMZ.

The purpose of the general wildlife survey was to document the general animal communities occurring within the OSMZ. As such, all vertebrate animals encountered during the survey, or otherwise detected, were identified to species and recorded. In addition, the number and location of all threatened and/or endangered species encountered were also documented. Due to the special nature of bats, specific surveys were conducted in an effort to document summer use of the OSMZ by this unique group of mammals. Although a survey targeting invertebrates was not undertaken, many identifiable invertebrates were also documented. While a botanical survey has also been completed for this project, a reduced botanical evaluation was completed during this survey due to its importance in identifying potential vertebrate species.

Methods

Plant Community

The plant communities within the project area were identified based on the dominant species. The identification of plant communities generally followed Holland (1986).

Wildlife Survey

Prior to conducting a general wildlife survey of the site, a review of potential sensitive species was completed. The potential for a species to occur within the project area was based on the geographic range of the species and the apparent presence of suitable habitat. Suitable habitat was based on the general type of plant community or communities associated with a species. The general wildlife survey for invertebrates and vertebrates was accomplished by walking the edge of the riparian plant communities located along the Santa Margarita River and Sandia Creek. In addition, portions of the upland communities were also surveyed where access permitted. Daylight surveys of the site were completed on June 17, 18, 20; Jul 3, 11, 15, & 29. Night surveys were also completed on Jul 3, 15, & 19. Additional surveys were completed by John Konecny, Konecny Biological Services, on June 23, 26, and 27, and July 1, 3, and 30.

Bat Survey

The night surveys focused primarily on the local bat fauna but also included nocturnal mammals. All bat surveys were conducted adjacent to the Santa Margarita River and Sandia Creek. Surveys were initiated just before sunset and continued to around midnight. Bat calls were recorded along the Santa Margarita River from the parking area located near the junction of De Luz Road and Sandia Creek Road, upstream to approximately 0.25 miles past the parking area for the Sandia Creek Trail (a distance of approximately 2 miles). Sandia Creek was surveyed from the confluence of the creek with the Santa Margarita River, upstream to the point the creek diverged from the road and access was no longer possible (a distance of approximately 3 miles). The ultrasonic calls of bats were recorded using a Pettersson Ultrasound Detector D 240x, and two

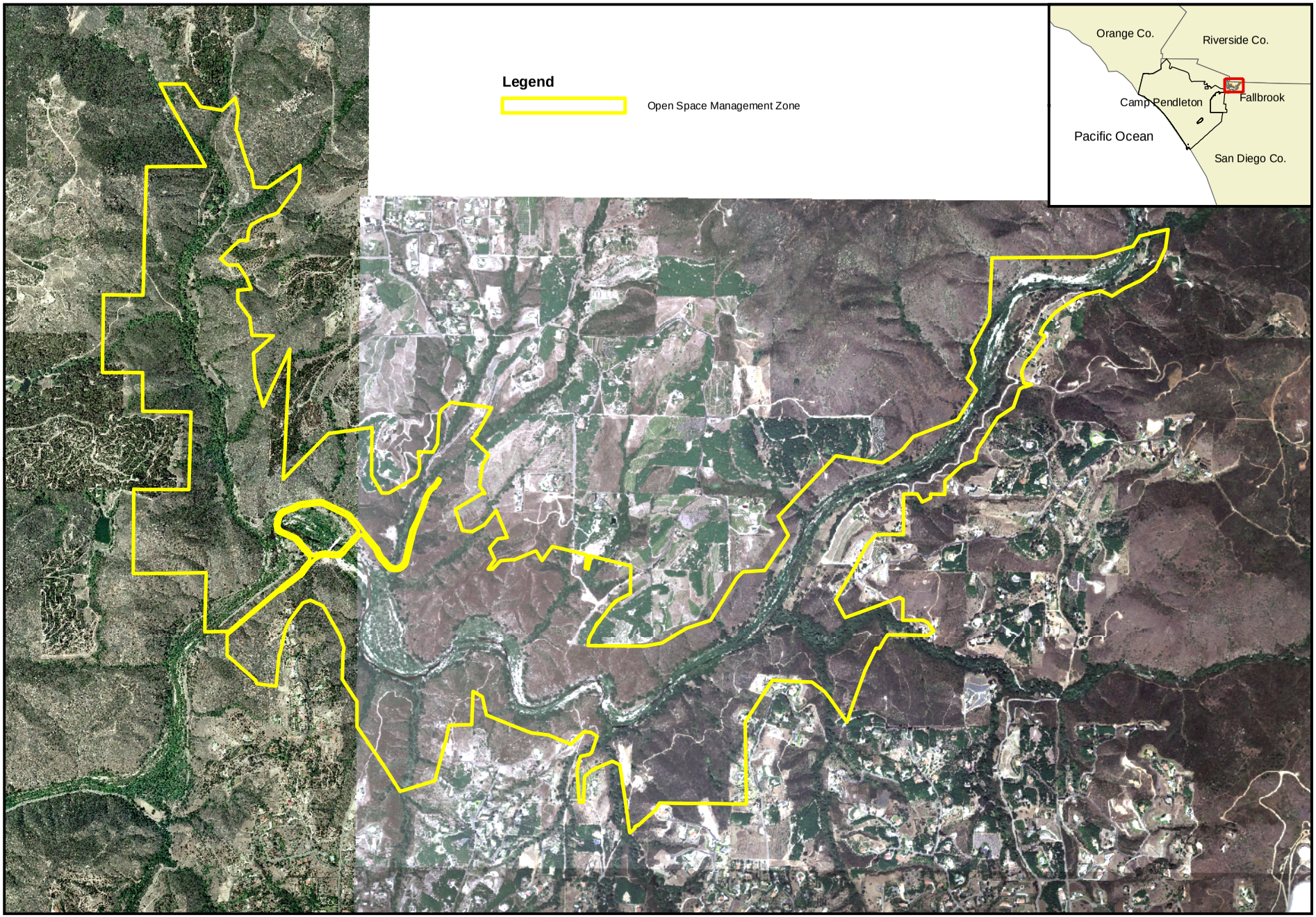

Figure 1. Santa Margarita River Conjunctive Use Project Open Space Management Zone.

digital recorders; both a Zoom Handy Recorder H2 and an Olympus Digital Voice Recorder VN-480 were used. All calls were later processed and identified to species using SonoBat 2.5.

Landscape
In addition to the potential presence of sensitive wildlife resources on site, the location of the site was qualitatively assessed as to its spatial importance to other natural communities and their associated biological communities. The purpose of this initial assessment was to evaluate the potential role the parcel could play in maintaining biological connectivity and integrity within this and adjacent areas.

An attempt was made to use the current scientific and standard English names for the animals encountered during this survey. As such, several references were used (Butterflies: Opler and Warren 2003; Dragonflies and Damselflies: Manolis 2003; Fish: Nelson et. al 2004; Reptiles and Amphibians: Crother et. al. 2000, Corther et al. 2003; Mammals: Hall 1981, Ingles 1965; and Birds: AOU Checklist 1998).

Results

Plant Community
Within the project area, the riparian forest located along the Santa Margarita River is composed of southern cotton wood willow riparian forest, southern coast live oak riparian forest, and southern willow scrub. Southern willow scrub appears to be the most common riparian plant community along the Santa Margarita River. The riparian plant community along Sandia Creek appears to be dominated by southern coast live oak riparian forest with embedded pockets southern willow scrub. The upland plant communities include chamise chaparral and coastal sage scrub. The coastal sage scrub includes both California buckwheat dominated and California sage brush dominated patches. Burned areas of chamise chaparral are currently dominated by California buckwheat dominated coastal sage scrub. These burned areas are expected to shift back to chamise dominated chaparral in the future.

Wildlife Survey
Based on a review of information regarding the distribution of Federal and State threatened and endangered species (e.g., listing documents, recovery plans, other literature), and the plant communities located within the project area, nine different listed animals were determined to have the potential to occur within the OSMZ (Table 1).

Table 1. List of potential Federal and State listed endangered and threatened species; based on geographic location of OSMZ and general distribution of species.

Common Name	**Scientific Name**	**Status**
Quino checkerspot butterfly	*Euphydryas editha quino*	FE
Steelhead trout	*Oncorhynchus mykiss*	FT
Western yellow-billed cuckoo	*Coccyzus americanus*	FC, SE
Least Bell's vireo	*Vireo bellii pusillus*	FE, SE
Southwestern willow flycatcher	*Empidonx traillii extimus*	FE, SE
Willow flycatchers (all subspecies)	*Empidonax traillii*	SE
Coastal California gnatcatcher	*Polioptila californica californica*	FT
California red-legged frog	*Rana aurora draytonii*	FE
Arroyo toad	*Bufo californicus*	FE

FE: Federal Endangered; FT; Federal Threatened; FC: Federal Candidate; SE; State Endangered; ST: State Threatened

In addition to the threatened and endangered species, 32 sensitive animal species were also determined to have potential to occur within the project area (Table 2). For the purpose of this report, sensitive species are those listed by the State as being "species of special concern." Species of special concern are designated based on declining population levels, limited ranges, and/or continuing threats that have made them vulnerable to extinction (CDFG 2006).

Table 2. Potential sensitive animals; based on general location of project and habitat affinities of each species.

Common Name	**Scientific Name**	**CDFG Status**
Hermes copper	*Lycaena hermes*	CDFG: SSC
Pacific lamprey	*Lampetra tridentate*	CDFG: SSC
Steelhead	*Oncorhynchus mykiss*	CDFG: SSC
Arroyo chub	*Gila orcutti*	CDFG: SSC
Coast range newt	*Taricha torosa torosa*	CDFG: SSC
Western spadefoot toad	*Spea hammondii*	CDFG: SSC
Western pond turtle	*Clemmys marmorata pallida*	CDFG: SSC
San Diego horned lizard	*Phrynosoma coronatum blainvillei*	CDFG: SSC
Belding's orange-throated whiptail	*Aspidoscelis hyperythrus beldingi*	CDFG: SSC
Silvery legless lizard	*Anniella pulchra pulchra*	CDFG: SSC
Coast patch-nosed snake	*Salvadora hexalepis virgultea*	CDFG: SSC
Two-striped garter snake	*Thamnophis hammondii*	CDFG: SSC
Northern red diamond rattlesnake	*Crotalus ruber*	CDFG: SSC
Cooper's hawk	*Accipiter cooperi*	CDFG: SSC
Burrowing owl	*Sthene cunicularia*	CDFG: SSC
Loggerhead shrike	*Lanius ludovicianus*	CDFG: SSC
Yellow warbler	*Dendroica petechia brewsteri*	CDFG: SSC
Yellow-breasted chat	*Icteria virens*	CDFG: SSC
Southern California rufous-crowned sparrow	*Aimophila ruficeps canescens*	CDFG: SSC
Bell's sage sparrow	*Amphispiza belli belli*	CDFG: SSC
Northwestern San Diego pocket mouse	*Chaetodipus fallax fallax*	CDFG: SSC
California leaf-nosed bat	*Macrotus californicus*	CDFG: SSC
Pallid bat	*Antrozous pallidus*	CDFG: SSC
Townsend's big-eared bat	*Corynorhinus townsendii*	CDFG: SSC
Spotted bat	*Euderma maculatum*	CDFG: SSC
Western mastiff bat	*Eumops perotis californicus*	CDFG: SSC
Big free-tailed bat	*Nyctinomops macrotis*	CDFG: SSC
Dulzura pocket mouse	*Chaetodipus californicus femoralis*	CDFG: SSC
Northwestern San Diego pocket mouse	*Chaetodipus fallax fallax*	CDFG: SSC
San Diego desert woodrat	*Neotoma lepida intermedia*	CDFG: SSC
Ramona grasshopper mouse	*Onochomys torridus ramona*	CDFG: SSC
American badger	*Taxadea taxus*	CDFG: SSC

CDFG: California Department of Fish and Game; SSC: Species of Special Concern

Wildlife Survey

A high diversity (richness and abundance) of invertebrates and vertebrates was observed during this survey. In both total numbers, and number of unique species, birds accounted for the majority of vertebrates observed. Lists of all invertebrates and vertebrates observed or otherwise detected are provided (Appendices 1 and 2).

Invertebrates

Focused surveys were not completed for invertebrates. However, many species were observed and identifiable to species. The most obvious species included butterflies such as the western

tiger swallowtail (*Papilio rutulus*), checkered white (*Pontia protodice*), mourning cloak (*Nymphalis antiopa*), common buckeye (*Junonia coenia*), Lourquin's admiral (*Liminitis lourquini*), California sister (*Adelpha bredowii*), Mormon metalmark (*Apodemia mormo*), Acmon blue (*Icaricia acmon*), and fiery skipper (*Hylephila phyeus*). Other noticeable species included several species of dragonflies such as the firery skimmer (*Hylephila phyeus*) and California darner (*Aeshna californica*).

Fish

Although specific surveys were not completed for fish, one native fish, the arroyo chub (*Gila orcutti*), was abundant and commonly observed within the Santa Margarita River. In addition to the arroyo chub, three exotic fish, the mosquito fish (*Gambusia affinis*), bluegill (*Lepomis macrochirus*), and common carp (*Cyprinus carpio*), were also observed.

Amphibians

Two native amphibians, the California toad (*Bufo boreas halophilus*), and Pacific tree frog (*Pseudacris regilla*), were also abundant and commonly observed within the Santa Margarita River. The Pacific tree frog was also common within Sandia Creek.. The bullfrog (*Rana catesbeiana*) was also present and was heard calling from several deep pools.

Reptiles

Despite the appropriateness of the habitat for most of southern California's native reptiles, only a few reptiles were observed during this survey. Reptiles observed included the western pond turtle (*Clemmys marmorata pallida*), western skink (*Eumeces skiltonianus*), Belding orange-throated whiptail (*Cnemidophorus hyperythrus beldingi*), western fence lizard (*Sceloporus occidentalis*), alligator lizard (*Gerrhonotus multicarinatus*), and southern Pacific rattlesnake (*Crotalus oreganos helleri*).

Mammals

Other than bats, mammals detected during this survey included the big-eared woodrat (*Neotoma macrotus*), California ground squirrel (*Spermophilus beecheyi nudipus*), desert cottontail rabbit (*Sylvilagus audobonii sanctidiegi*), stripped skunk (*Mephitis mephitis holzneri*), western spotted skunk (*Spilogale gracilis*), long-tailed weasel (*Mustela frenata*), coyote (*Canis latrans clepticus*), and bobcat (*Lynx rufus californicus*).

Bats

Seven species of bats were found to be occupying the site. Bats detected during this summer survey included the big brown bat (*Eptesicus fuscus*), Silver-haired bat (*Lasionycteris noctivagans*), western red bat (*Lasiurus blossevillii*), California bat (*Myotis californicus*), western small-footed bat (*Myotis ciliolabrum*), western pipistrelle bat (*Pipistrellus Hesperus)*, and Brazilian free-tailed bat (*Tadarida brasiliensis*).

Birds

Sixty-three species of birds were detected during surveys of the site. In both total number, and number of unique species, birds accounted for the majority of vertebrates observed. Several nesting pairs of least Bell's vireo (*Vireo bellii pusillus*) were observed within and adjacent to the riparian plant communities associated with the Santa Margarita River and near the mouth of Sandia Creek (Table 3). In addition, least Bell's vireos were observed nesting in the coast live oak woodlands that bordered the Santa Margarita River.

Table 3. Locations of least Bell's vireo territories (UTM, NAD 83, Zone 11; +/-5 meters).

Record	Species	Status	Easting	Northing
1	LBVI	Pair	0477766	3696590
2	LBVI	Pair	0478026	3696510
3	LBVI	Pair	0478166	3696572
4	LBVI	Pair	0478318	3696700
5	LBVI	Pair	0476606	3695873
6	LBVI	Pair	0476760	3696439
7	LBVI	Pair	0477574	3697187

LBVI: Least Bell's vireo

Landscape Connectivity

In regard to maintaining biological diversity within the region, the site is located in a very important area in southern California. The Santa Margarita River and adjacent upland plant communities connect interior biological communities in San Diego County to large blocks of natural habitat located along the coast (e.g., Santa Margarita and Santa Ana Mountains). This connection is important in maintaining the biological connectivity of the region and gene flow for many terrestrial species.

Discussion

Plant Communities

The riparian plant communities located along the Santa Margarita River and Sandia Creek are robust and diverse. Several species of willows as well as Freemont cottonwood, western sycamore, and coast live oak are common along these waterways. The upland plant communities include chamise chaparral and coastal sage scrub. The coastal sage scrub includes both California buckwheat dominated and California sage brush dominated patches. Burned areas of chamise chaparral are currently dominated by California buckwheat dominated coastal sage scrub and are expected to shift back to a chamise chaparral in the future. Although all native plant communities appeared to be robust, non-native plant species were evident throughout the project area. Because of the variety of plant communities, and their generally good condition, a large number of species of animals are anticipated to occur within the OSMZ.

Invertebrates

The invertebrate community appears to be robust. Although focused surveys designed to quantify the different distributions and numbers of various taxonomic groups (e.g., species) were not completed during this survey, a large variety of both aquatic and terrestrial invertebrates were observed.

Amphibians

The number of amphibians detected is significantly lower than expected for the project area. The reason for the difference is likely due to the time of year the survey was completed. Most of the species are active during the cooler, wetter times of the year and are generally deep within burrows and other protected areas by early summer. Based on the suitability of habitat, the California newt (*Taricha torosa*), Montrey salamander (*Ensatina eschscholtzii eschscholtzii*), arboreal salamander (*Aneides lugubris*), garden slender salamander (*Batrachoseps pacificus major*), western spadefoot (*Spea hammondii*), and arroyo toad (*Bufo californicus*), are all anticipated to occur within the project area.

Another endangered species, the red-legged frog (*Rana aurora draytonii*) may remain in the Santa Margarita River. However, this species has not been observed in the Santa Margarita River in recent years. The closest remaining population of California red-legged frog persisted on the Santa Rosa Plateau until the mid to late 1990's, but appears to have been extirpated. From a recovery perspective, the Santa Margarita River provides an important opportunity for reintroduction of this species. However, an exotic control program that targets non-native species such as the bullfrog, bluegill, and common carp is needed.

Reptiles

The number of reptiles detected is also significantly lower than expected for the OSMZ. Given the suitability of habitat and distribution of many species, most of the species that are likely present went undetected during this survey. The reason for the low number of observed reptiles is due to the time of year of the survey and the survey methodology. In order to accurately and efficiently detect the majority of reptilian species, numerous pit-fall arrays and traps would need to installed in the various plant communities present within the project area. The survey period would also need to span the active period of each of these species (i.e., spring, summer, fall, and winter). Species that were not detected, but likely occur in the project area include the San Diego banded gecko (*Coleonyx variegates abbotti*), San Diego coast horned lizard (*Phrynosoma coronatum blainvellii*), coastal western whiptail (*Aspidoscelis tigris multiscutatus*), silvery legless lizard (*Aniella pulchra pulchra*), coastal rosy boa (*Lichanura trivirgata roseofusca*), San Diego ring-necked snake (*Diadophis punctatus similes*), western yellow-bellied racer (*Coluber constrictor mormon*), red coachwhip (*Masticophis flagellum piceus*), chaparral whipsnake (*Masticophis lateralis lateralis*), coast patch-nosed snake (*Salvadora hexalepis virgultea*), California glossy snake (*Arizona elegans occidentalis*), San Diego gopher snake (*Pituophis melanoleucus annectens*), California kingsnake (*Lampropeltis getulus californiae*), western long-nosed snake (*Rhinocheilus lecontei lecontei*), Hammond's two-stripped garter snake (*Thamnophis hammondii hammondii*), California black-headed snake (*Tantilla planiceps*), California lyre sanke (*Trimorphodon biscutatus vandenburghi*), night snake (*Hypsiglena torquata*), northern red diamond rattlesnake (*Crotalus rubber ruber*), and southwestern speckled rattlesnake (*Crotalus mitchellii pyrrhus*).

Mammals

The number of mammalian species detected is also significantly lower than the number expected to occur in this area. The reason for this is the nocturnal nature of most mammals. In addition, most mammals are very shy and avoid people. Thus, visual surveys typically detect few of the mammals that are present. In order to efficiently detect the majority of mammal species using this area, several small mammal trapping grids, pitfall arrays, track stations, and scent/photo traps would need to be established in each plant community. Native mammals that were not detected, but likely occur in the project area include the ornate shrew (*Sorex ornatus ornatus*), gray shrew (*Notiosorex crawfordi crawfordi*), broad-handed mole (*Scapanus latimanus occultus*), brush rabbit (*Sylvilagus bachmani cinerascens*), San Diego pocket mouse (*Chaetodipus fallax fallax*), California pocket mouse (*Chaetodipus californicus californicus*), Dulzura kangaroo rat (*Dipodomys simulans*), western harvest mouse (*Reithrodontomys megalotis longicaudus*), California mouse (*Peromyscus californicus insignis*), cactus mouse (*Peromyscus eremicus fraterculus*), brush mouse (*Peromyscus boylii rowleyi*), deer mouse (*Peromyscus maniculatus gambelii*), Ramona grasshopper mouse (*Onychomys torridus ramona*), desert wood rat (*Neotoma lepida intermedia*), California meadow mouse (*Microtus californicus sanctidiegi*), gray fox (*Urocyon cinereoargenteus californicus*), raccoon (*Procyon lotor psora*), ringtail (*Bassariscus astutus octavus*), long-tailed weasel (*Mustela frenata latirostra*), spotted skunk (*Spilogale putorius phenax*), badger (*Taxidea taxus jeffersonii*), and mountain lion (*Felis concolor californica*).

Bats
Seven species of bats were found occupying the site during this summer survey. Additional bat species would likely be detected during an expanded survey that included the spring and fall (Table 4). Based on the location and number of calls, the foraging habitat for all of the detected species appeared to overlap to large degree, and focus around the riparian plant community. A spring survey would likely detect various species of bats using an expanded area that included the chaparral and coastal sage scrub located on the hillsides bordering the Santa Margarita River and Sandia Creek. The riparian plant community provides unlimited roosting opportunities for species such as the western red bat and western small-footed bat. In addition, numerous roosting opportunities for rock crevice roosters such as the Brazilian free-tailed bat and western pipistrelle are also available within the project area.

Table 4. Other species of bats that may use habitat within the project area at different times of the year and to differing degrees.

Common Name	**Scientific Name**
California leaf-nosed bat	*Macrotus californicus*
Western long-eared bat	*Myotis evotis*
Fringed bat	*Myotis thysanodes*
Long-legged bat	*Myotis volans*
Yuma bat	*Myotis yumanensis*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Corynorhinus townsendii*
Western mastiff bat	*Eumops perotis californicus*
Big free-tailed bat	*Nyctinomops macrotis*

Birds
The number of birds detected is typical of robust riparian woodland plant communities in coastal southern California. The presence of nesting least Bell's vireos in many of the suitable patches of habitat underscores the importance of riparian habitat within the OSMZ to the continuing recovery of this species. During a least Bell's vireo survey of the upper Santa Margarita River in the early 1990's, from the De Luz Road crossing on Marine Corps Base Camp Pendleton (Base), to the eastern edge of the Base near Fallbrook, no least Bell's vireo were observed in this area (A. Davenport, pers. obs.).

Suitable habitat for the southwestern willow flycatcher also occurs within the OSMZ. Although a focused survey was not completed, and the species not detected during the general wildlife survey, the southwestern willow flycatcher is anticipated to occur within the project area during migration. In addition, due to the presence of high quality habitat, southwestern willow flycatchers may currently nest within the project area. Due to the difficulty of detecting this species during various phases of its nesting cycle, a focused survey would be necessary to quantify the number and location of southwestern willow flycatchers within this area.

Suitable habitat for the western yellow-billed cuckoo also occurs within the OSMZ. A focused survey was not completed for this species during this study. However, yellow-billed cuckoos have been documented within recent years along the San Luis Rey River as well as the Santa Margarita River (A. Davenport, pers. obs.).

Landscape Connectivity
As previously discussed, the OSMZ is located in a very important area for maintaining regional biological diversity. The Santa Margarita River and adjacent upland plant communities connect

interior biological communities in San Diego County to large blocks of natural habitat located along the coast (e.g., Santa Margarita and Santa Ana Mountains). This connection is important in maintaining the biological connectivity of the region and gene flow for many terrestrial species. Without this connection, the movement of terrestrial animals and/or gene flow within and between populations over large regions of southern California will cease for many species. The absence or reduction in gene flow may result in diminished genetic diversity and the ability of a species to adapt to changing environmental conditions. In addition, the loss of connection between populations located in different regions may increase the probability of extinction for isolated populations too small to maintain viability.

Conclusion

The Santa Margarita River, Sandia Creek, and adjacent uplands within the OSMZ provide high value habitat for a large number of California endemic species. The OSMZ is regionally important to the conservation of southern California's endemic species.

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Appendix 1. Invertebrate Animals Observed within Project Area.

Lepidopters (Butterlies and Moths)

Hesperiidae (Skippers)	
Fiery skipper	*Hylephila phyeus*
Lycaenidae (Coppers, Hairstreaks, Blues)	
Acmon blue	*Icaricia acmon*
Nymphalidae (Brushfoot Butterflies)	
Mourning cloak	*Nymphalis antiopa*
Common buckeye	*Junonia coenia*
Lourquin's admiral	*Liminitis lourquini*
California sister	*Adelpha bredowii*
Papilionidae (Parnassians, Swallowtails)	
Western tiger swallowtail	*Papilio rutulus*
Pieridae (Whites, Sulfurs)	
Checkered white	*Pontia protodice*
Riodinidae (Metalmarks)	
Mormon metalmark	*Apodemia mormo*

Odonata (Dragonflies and Damselflies)

Aeshnidae (Darners)	
California darner	*Aeshna californica*
Libellulidae (Skimmers, Emeralds, Baskettails, Cruisers)	
Flame skimmer	*Libellula saurata*

Appendix 2. Vertebrate Animals Observed within Project Area.

FISH

Centrarchidae (Sunfishes, Basses)

Bluegill	*Lepomis macrochirus*

Cyprinidae (Minnows)

Arroyo chub	*Gila orcutti*
Common carp	*Cyprinus carpio*

Poeciliidae (Livebearers)

Mosquito fish	*Gambusia affinis*

AMPHIBIANS

Bufonidae (True Toads)

Western toad	*Bufo borea halophilus*

Hylidae (Tree frogs)

Pacific tree frog	*Pseudacri regillia*

Ranidae (True frogs)

Bull frog	*Rana catesbiana*

REPTILES

Emydidae (Box, Water Turtles)

Western pond turtle	*Clemmys marmorata pallida*

Iguanidae (Iguanid Lizards)

Western fence lizard	*Sceloporus occidentalis*

Scincidae (Skinks)

Western skink	*Eumeces skiltonianus*

Teiidae (Whiptails, Allies)

Belding orange-throated whiptail	*Cnemidophorus hyperythrus beldingi*

Anguidae (Alligator Lizards, Allies)

Southern Alligator Lizard	*Gerrhonotus multicarinatus*

Viperidae (Vipers)

Pacific rattlesnake	*Crotalus oreganos hellerii*

Appendix 2. Vertebrate Animals Observed within Project Area (Cont.).

BIRDS

Anatidae (Ducks, Geese, Swans)	
Mallard	*Anas platyrhynchos*
Odontophoridae (New World Quail)	
California quail	*Callipepla californica*
Ardeidae (Herons, bitterns, allies)	
Green heron	*Butorides virescens*
Great blue heron	Ardea herodias
Cathartidae (New World Vultures)	
Turkey vulture	*Cathartes aura*
Accipitridae (Hawks, Kites, Eagles, Allies)	
Cooper's hawk	*Accipiter cooperii*
Red-shouldered hawk	*Buteo lineatus*
Red Tailed Hawk	*Buteo jamaicensis*
Falcondidae (Caracaras, Falcons)	
American kestrel	*Falco sparverius*
Rallidae (Rails, Gallinules, Coots)	
Virginia rail	*Rallus limicola*
Columbidae (Pigeons, Doves)	
Mourning dove	*Zenaida macroura*
Tytonidae (Barn Owls)	
Barn owl	*Tyto alba*
Strigidae (Typical Owls)	
Great horned owl	*Bubo virginianus*
Caprimulgidae (Goatsuckers)	
Lesser nighthawk	*Chordeiles acutipennis*
Trochilidae (Hummingbirds)	
Black-chinned hummingbird	*Archilochus alexandri*
Costa's hummingbird	*Calypte costae*
Anna's hummingbird	*Calypte anna*
Allen's hummingbird	*Selasphorus sasin*

Appendix 2. Vertebrate Animals Observed within Project Area (Cont).

Alcedinidae (Kingfishers)	
Belted kingfisher	*Ceryle alcyon*
Picidae (Woodpeckers, allies)	
Acorn woodpecker	*Melanerpes formicivorus*
Northern flicker	*Colaptes auratus*
Nuttal's woodpecker	*Picoides nuttallii*
Tyrannidae (Tyrant Flycatchers)	
Western wood-pewee	*Contopus sordidulus*
Pacific-slope flycatcher	*Empidonax difficilis*
Black phoebe	*Sayornis nigricans*
Ash-throated flycatcher	*Myiarchus cinerascens*
Cassin's kingbird	*Tyrannus vociferans*
Vireonidae (Vireos)	
Least Bell's vireo	*Vireo bellii pusillus*
Hutton's vireo	*Vireo huttoni*
Warbling vireo	*Vireo gilvus*
Corvidae (Crows, Jays)	
Western scrub-jay	*Aphelocoma californica*
Common raven	*Corvus corax*
American crow	*Corvus brachyrhynchos*
Hirundinidae (Swallows)	
Tree swallow	*Tachycineta bicolor*
Cliff swallow	*Petrochelidon pyrrhonota*
Northern rough-wing swallow	*Stelgidopteryx serripennis*
Timaliidae (Babblers)	
Wrentit	*Chamaea fasciata*
Paridae (Chickadees, Titmice)	
Oak titmouse	*Baeolophus inornatus*
Aegithalidae (Long-tailed tits, bushtits)	
Bushtit	*Psaltriparus minimus*
Troglodytidae (Wrens)	
House wren	*Troglodytes aedon*
Bewick's wren	*Thryomanes bewickii*
Sylviidae (Old World Warblers, Gnatcatchers)	
Blue-gray gnatcatcher	*Polioptila caerulea*
Turdidae (Thrushes)	
Western bluebird	*Sialia mexicana*

Appendix 2. Vertebrate Animals Observed within Project Area (Cont).

Mimidae (Mockingbirds, Thrashers)	
Northern mockingbird	*Mimus polyglottos*
California thrasher	Toxostoma redivivum
Ptilogonatidae (Silky-flycatchers)	
Phainopepla	*Phainopepla nitens*
Parulidae (Wood-warblers)	
Orange-crowned warbler	*Vermivora celata*
Yellow warbler	*Dendroica petechia*
Common yellowthroat	*Geothlypis trichas*
Yellow-breasted chat	*Icteria virens*
Emberizidae (Emberizids)	
California towhee	*Pipilo crissalis*
Spotted towhee	*Pipilo maculatus*
Lark sparrow	*Chondestes grammacus*
Song sparrow	*Melospiza melodia*
Cardinalidae (Cardinals, Saltators, Allies)	
Black-headed grosbeak	*Pheucticus melanocephalus*
Blue grosbeak	*Passerina caerulea*
Icteridae (Blackbirds)	
Red-winged blackbird	*Agelaius phoeniceus*
Brown-headed cowbird	*Molothrus ater*
Hooded oriole	*Icterus cucullatus*
Bullock's oriole	*Icterus bullockii*
Fringillidae (Fringilline and Cardueline Finches, Allies)	
House finch	*Carpodacus mexicanus*
American goldfinch	*Carduelis tristis*
Lesser goldfinch	*Carduelis psaltria*
MAMMALS	
Canidae (Coyote, Wolves, Foxes, Dogs)	
Coyote	*Canis latrans clepticus*
Felidae (Cats, Allies)	
Bobcat	*Lynx rufus*
Leporidae (Rabbits, Hares)	
Desert cottontail	*Sylvilagus audubonii*
Sciuridae (Squirrels and Relatives)	
California ground squirrel	*Spermophilus beecheyi*

Appendix 2. Vertebrate Animals Observed within Project Area (Cont).

Mustelidae (Weasels and Relatives)

Long-tailed weasel	*Mustela frenata*
Western spotted skunk	*Spilogale gracilis*

Geomyidae (Pocket Gophers)

Valley pocket gopher	*Thomomys bottae*

Muridae (Murids)

Big-eared woodrat	*Neotoma macrotis*

Appendix C-4

Resource Effects Model for Federally-listed Species

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Table C-5. Santa Margarita River Conjunctive Use Project
Construction Resource Effect Model for Federally Listed Species

Species	Permanent Direct Effect	Temporary Direct Effect	Indirect Effects
	Permanent Direct: irreversible construction effects within the permanent direct impact area as a result of project implementation; i.e., all proposed development features (Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipelines, Access Roads, Booster Pump Stations, etc).	*Temporary Direct[1]: reversible construction effects within the temporary direct impact area; e.g., temporary trenches for pipeline, temporary work zones, construction staging within sites outside of permanent developed areas.*	*Construction Indirect Effects (500-foot buffer): Project effects within 500-ft of construction that are indirectly related to project implementation; effects that occur adjacent to the project footprint later in time (e.g., noise effects from construction).* *Operational Project Effects: effects within the Action Area from the proposed operation of the project (e.g., pumping from the groundwater wells, and diversion of water from the weir), that are to occur later in time.*
Arroyo Toad	Habitat: Effects to occupied breeding habitat[2] (defined as all suitable riparian habitat [less if there is a physical barrier, e.g., elevated dirt road] within an 82-foot elevation buffer) within the proposed development features (i.e., permanent impacts). Effects to occupied aestivation/movement habitat[3] (defined as an 82-foot elevation upland buffer adjacent to occupied riparian habitat [less if there is a physical barrier, e.g., Vandegrift Blvd. or Lake O'Neill]) within the proposed development features. Individual: The number of individuals impacted is determined by multiplying the total permanent and temporary impact acreage by the density of arroyo toad per acre, named in USFWS 2010; in USFWS 2010, effects to individuals are defined as 4.6 arroyo toads/acre in riparian (i.e., breeding) habitat and 0.72 arroyo toads/acre in upland (i.e., aestivation) habitat.	Habitat: Effects to occupied breeding or aestivation/movement habitat (as defined in the "Habitat" effects determination in arroyo toad "Permanent Direct Effect" analysis) within the temporary direct impact area. Individual: See "Individual" effects determination in arroyo toad "Permanent Direct Effect" analysis. The number of individuals impacted in temporary impact areas is combined with those in permanent impact areas.	Construction (500-foot buffer): Not significant Operational: Determined in the USFWS Section 7 Consultation (USFWS 2016). Future CUP operations will lead to a predicted average 11.6 percent decline in surface flows and a 10.2 percent decline in evapotranspiration on the Lower SMR, with a corresponding decline in loss of habitat and decline in the ARTO population.

Species	Permanent Direct Effect	Temporary Direct Effect	Indirect Effects
	Permanent Direct: irreversible construction effects within the permanent direct impact area as a result of project implementation; i.e., all proposed development features (Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipelines, Access Roads, Booster Pump Stations, etc).	*Temporary Direct[1]: reversible construction effects within the temporary direct impact area; e.g., temporary trenches for pipeline, temporary work zones, construction staging within sites outside of permanent developed areas.*	*Construction Indirect Effects (500-foot buffer): Project effects within 500-ft of construction that are indirectly related to project implementation; effects that occur adjacent to the project footprint later in time (e.g., noise effects from construction).* *Operational Project Effects: effects within the Action Area from the proposed operation of the project (e.g., pumping from the groundwater wells, and diversion of water from the weir), that are to occur later in time.*
Least Bell's Vireo	Habitat: Effects to vireo-occupied habitat is defined as riparian scrub and riparian woodland[4] that occurs within 152 m (500 ft) of any documented vireo location (1995-2014 on MCBCP; 1993-2014 on DET Fallbrook), within the proposed development features (i.e., permanent impacts). Individual: Effects to LBVI territories defined as riparian scrub and riparian woodland[4] within 0.8 ha (1.9 ac) [5] of each of the vireo territory locations documented in 2010 and 2014 on MCB Camp Pendleton[6] and 2008 and 2013 on DET Fallbrook[6] within the proposed development features. An impact to ≥20% of a territory is assumed to have a substantial increase in mortality or reproductive output of the LBVI assumed pair (i.e., "take"). Both permanent and temporary impacts are combined for the analysis.	Habitat: Effects to vireo-occupied habitat is defined as riparian scrub and riparian woodland[4] that occurs within 152 m (500 ft) of any documented vireo location (1995-2014 on MCBCP; 1993-2014 on DET Fallbrook), within the temporary impact area. Individual: See "Individual" effects determination in least Bell's vireo "Permanent Direct Effect" analysis. The number of individual territories impacted in temporary impact areas is combined with those in permanent impact areas, noting that the temporary impacts would occur for 2-5 years until the habitat can be restored.	Construction (500-foot buffer): Indirect effects to territories defined as the number of territories (LBVI points+ 162ft buffer of riparian habitat[4]) within the 500-foot site buffers documented in 2010/2014 on MCB Camp Pendleton[6] and 2008/2013 on DET Fallbrook[6]. Operational: Determined in the USFWS Section 7 Consultation (USFWS 2016). Future CUP operations will lead to a predicted average 11.6 percent decline in surface flows and a 10.2 percent decline in evapotranspiration on the Lower SMR, with a corresponding decline in loss of habitat and the carrying capacity for LBVI.

Species	Permanent Direct Effect	Temporary Direct Effect	Indirect Effects
	Permanent Direct: irreversible construction effects within the permanent direct impact area as a result of project implementation; i.e., all proposed development features (Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipelines, Access Roads, Booster Pump Stations, etc).	*Temporary Direct[1]: reversible construction effects within the temporary direct impact area; e.g., temporary trenches for pipeline, temporary work zones, construction staging within sites outside of permanent developed areas.*	*Construction Indirect Effects (500-foot buffer): Project effects within 500-ft of construction that are indirectly related to project implementation; effects that occur adjacent to the project footprint later in time (e.g., noise effects from construction).* *Operational Project Effects: effects within the Action Area from the proposed operation of the project (e.g., pumping from the groundwater wells, and diversion of water from the weir), that are to occur later in time.*
Southwestern Willow Flycatcher	Habitat: Effects to occupied habitat (defined as all riparian habitat[7] within delineated flycatcher territories, as determined through Basewide surveys from 2011-2014, or within 100 feet of these delineated territories) within the proposed facility sites and other work areas to be permanently developed. Individual: An individual impact analysis was not conducted since SWFL habitat/territories were not directly impacted.	Habitat: Effects to occupied habitat (defined as all riparian habitat[7] within delineated flycatcher territories, as determined through Basewide surveys from 2011-2014, or within 100 feet of these delineated territories) within the temporary direct impact area. Individual: An individual impact analysis was not conducted since SWFL habitat/territories were not directly impacted.	Construction (500-foot buffer): Indirect effects to territories (defined as all riparian habitat[7] within delineated flycatcher territories, as determined through Basewide surveys from 2011-2014) occur when territories overlap with the 500-foot site buffers. Operational: Determined in the USFWS Section 7 Consultation (USFWS 2016). Future CUP operations will lead to a predicted average 11.6 percent decline in surface flows and a 10.2 percent decline in evapotranspiration on the Lower SMR; however, this is offset with the placement of 3 artificial seeps to are expected to promote conditions favorable for SWFL.

Species	Permanent Direct Effect	Temporary Direct Effect	Indirect Effects
	Permanent Direct: irreversible construction effects within the permanent direct impact area as a result of project implementation; i.e., all proposed development features (Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipelines, Access Roads, Booster Pump Stations, etc).	*Temporary Direct[1]: reversible construction effects within the temporary direct impact area; e.g., temporary trenches for pipeline, temporary work zones, construction staging within sites outside of permanent developed areas.*	*Construction Indirect Effects (500-foot buffer): Project effects within 500-ft of construction that are indirectly related to project implementation; effects that occur adjacent to the project footprint later in time (e.g., noise effects from construction).* *Operational Project Effects: effects within the Action Area from the proposed operation of the project (e.g., pumping from the groundwater wells, and diversion of water from the weir), that are to occur later in time.*
Coastal California Gnatcatcher	Habitat: Effects to gnatcatcher-occupied habitat is defined as all Diegan coastal sage scrub that occurs within 152 m (500 ft) of any documented gnatcatcher location, within the proposed development features (i.e., permanent impacts). Individuals: Effects to CAGN territories defined as Diegan coastal sage scrub within 2.3 ha (5.7 ac)[8] of each of the gnatcatcher territory locations documented in 2010 and 2014 on MCB Camp Pendleton[9] and 2009 and 2014 on DET Fallbrook[9] within the proposed development features. An impact to ≥20% of a territory is assumed to have a substantial increase in mortality or reproductive output of the CAGN assumed pair (i.e., "take"). Both permanent and temporary impacts are combined for the analysis; note that temporary impacts were more than 99% of the impacts for the proposed project footprint.	Habitat: Effects to gnatcatcher-occupied habitat is defined as all Diegan coastal sage scrub that occurs within 152 m (500 ft) of any documented gnatcatcher location, within the temporary impact area. Individual: See "Individual" effects determination in coastal California gnatcatcher "Permanent Direct Effect" analysis. The number of individual territories impacted in temporary impact areas is combined with those in permanent impact areas; note that the temporary impacts were more than 99% of the impacts for the proposed project footprint and that the temporary impacts would occur for 4-5 years until the habitat can be restored.	Construction (500-foot buffer): Indirect effects to territories defined as the number of territories (CAGN points+282ft buffer of Diegan coastal sage scrub habitat) within the 500-foot site buffers documented in 2010/2014 on MCB Camp Pendleton[9] and 2009/2014 on DET Fallbrook[9]. Operational: Not significant

Species	Permanent Direct Effect	Temporary Direct Effect	Indirect Effects
	Permanent Direct: irreversible construction effects within the permanent direct impact area as a result of project implementation; i.e., all proposed development features (Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipelines, Access Roads, Booster Pump Stations, etc).	*Temporary Direct[1]: reversible construction effects within the temporary direct impact area; e.g., temporary trenches for pipeline, temporary work zones, construction staging within sites outside of permanent developed areas.*	*Construction Indirect Effects (500-foot buffer): Project effects within 500-ft of construction that are indirectly related to project implementation; effects that occur adjacent to the project footprint later in time (e.g., noise effects from construction).* *Operational Project Effects: effects within the Action Area from the proposed operation of the project (e.g., pumping from the groundwater wells, and diversion of water from the weir), that are to occur later in time.*
Stephens' Kangaroo Rat	Habitat: Effects to kangaroo rat-occupied habitat is defined as all Diegan coastal sage scrub and grassland that occurs within 50 m (164 ft) of any documented SKR trapped location, within the proposed development features (i.e., permanent impacts). Individuals: Effects to SKR territories defined as Diegan coastal sage scrub/grassland within 0.79 ha (1.94 ac) [10] of each of the SKR trap locations documented during the Fall 2015 survey effort. An impact to ≥20% of a territory is assumed to have a substantial increase in mortality or reproductive output of SKR (i.e., "take").	Habitat: Effects to kangaroo rat-occupied habitat is defined as all Diegan coastal sage scrub and grassland that occurs within 50 m (164 ft) of any documented SKR trapped location, within the temporary impact area. Individual: See "Individual" effects determination in Stephens' kangaroo rat "Permanent Direct Effect" analysis. The number of individual territories impacted in temporary impact areas is combined with those in permanent impact areas; note 100% of the impacts were temporary.	Construction (500-foot buffer): Not analyzed Operational: Not significant

Notes:

1 Temporary impacts include those impacts around the Diversion Weir, O'Neill Ditch, Production Wells, Conveyance Pipeline (approximately 50 foot corridor), Access Roads, Booster Pump Stations, Laydown Areas, Bi-Directional Pipeline (60% of an approximate 100 foot corridor + additional width needed for turns), and Water Treatment Plant.

2 Occupied arroyo toad breeding riparian habitat is defined as the entire extent of riparian habitat within the Base's 82-foot Elevation Arroyo Toad Buffer within the proposed project footprint. Specific notes are as follows:

- All wetland types should be included, unless location-specific analysis indicates that sufficient vegetative cover is lacking.
- Open water (Lake O'Neill) is not considered suitable habitat.
- Tidal and brackish water habitats are considered non-suitable wetlands.
- The following riparian habitat layers were considered in this analysis: Arundo-dominated riparian, cismontane alkali marsh, coastal and valley freshwater marsh, disturbed wetland, grass-forb mix, mixed willow exotic, mixed woodland, open water/open gravel, riparian forest, riparian woodland, southern coastal salt marsh, southern riparian scrub, southern riparian woodland, southern sycamore-alder riparian woodland, southern willow scrub, and tamarisk scrub.
- Consider whether occupied breeding habitat is interrupted by irregular project limits; such habitat may extend into other project areas.

3 Occupied aestivation/movement habitat is defined as all suitable aestivation and dispersal habitat within the Base's 82-foot Elevation Arroyo Toad Buffer within the proposed project footprint. Specific notes are as follows:

- All upland habitat types should be included, except developed areas and alkali playas.

- Arroyo toads may traverse some roadways and berms; consider location-specific conditions before excluding areas beyond such features. However, if there is a physical barrier (e.g., development or steep slopes), these are excluded.
- The following upland habitat layers were considered in this analysis: coast live oak woodland, coastal sage-chaparral, Diegan coastal sage scrub, Engelmann oak woodland, non-native grassland, scrub oak chaparral, valley and foothill grassland, and valley needlegrass grassland.
- Consider whether occupied aestivation/movement habitat is interrupted by irregular project limits; such habitat may extend into other project areas.

4 The following riparian habitat layers were considered in the LBVI habitat analysis on MCBCP: mixed woodland, riparian forest, riparian woodland, southern riparian scrub, southern riparian woodland, southern sycamore-alder riparian woodland, southern willow scrub. For Detachment Fallbrook data, the "Riparian" habitat layers were used.

5 Least Bell's vireo territory sizes were based on the average size of vireo territories, which was determined to be 1.9 acres (0.8 hectare/ 82,764 ft^2] or a 162-ft buffer radius (area =π[$radius^2$]), as defined in the BUI BO (USFWS 2010).

6 For MCB Camp Pendleton, the 2010 data was used because it was the highest recorded population documented on Base, and the 2014 data was used because it is the most recent data set. For DET Fallbrook, installation-wide surveys are conducted every five years, and the 2008 and 2013 data sets reflect the most robust data sets for the installation.

7 The following riparian habitat layers were considered in the SWFL habitat analysis on MCBCP: mixed woodland, riparian forest, riparian woodland, southern riparian scrub, southern riparian woodland, southern sycamore-alder riparian woodland, southern willow scrub. There is no breeding SWFL on Detachment Fallbrook.

8 Coastal California gnatcatcher territory sizes were based on the average size of gnatcatcher territories, which was determined to be 5.7 acres (2.3 hectares/ 248,293 ft^2) or a 282-ft buffer radius (area =π[$radius^2$]), as defined in the BUI BO (USFWS 2010).

9 On MCB Camp Pendleton, Base-wide surveys are scheduled every three to four years (most recently in 2010 and 2014); on Detachment Fallbrook, installation-wide surveys are conducted every five years (most recently in 2009 and 2014). 2010 represents a year with abundant winter rain; 2014 reflects a survey that overlaps with prolonged drought (3 years) and the May 2014 wildfires on MCB Camp Pendleton and Detachment Fallbrook. 2014 data on MCB Camp Pendleton and Detachment Fallbrook is draft data.

10 Stephens' kangaroo rat territory sizes were developed during Section 7 consultation with the USFWS and represent an estimate of SKR "typical movements", where the individual typically moves short distances (50 meters) within its home territory.

Appendix C-5

Listed Species Construction Effects Analysis

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Direct Effects to Least Bell's Vireo (LBVI) Territories

With project construction of Alternative 1, there is a total potential effect to approximately 14.16 acres of least Bell's vireo occupied habitat (2.20 acres permanent; 11.96 acres temporary). The amount of each 1.9-acre LBVI territory in 2010 and 2014 on MCB Camp Pendleton is noted in Table C-6; no 2008 or 2013 Detachment Fallbrook least Bell's vireo territories were impacted by the project footprint. Territory names in Table C-6 correspond to those locations in Figures C-6 through C-11. A territory is considered significantly impacted if greater than 20% will be removed.

Table C-6.

Percent Impact on LBVI Territories on MCB Camp Pendleton[1]

2010 Territory Name	Amount of Riparian[2] Habitat in 1.9 acre (162-ft buffer) Territory	Amount of Riparian[2] Habitat Permanently Impacted within 1.9 acre Territory	Amount of Riparian[2] Habitat Temporarily Impacted within 1.9 acre Territory	% Territory Impacted[3]
2010LBVI_01M	0.90	0.10	0.22	35.6
2010LBVI_02M	1.49	0.20	0.26	30.9
2010LBVI_03M	1.21	0.09	0.11	16.5
2010LBVI_04M	0.53	0.02	0.09	20.8
2010LBVI_05M	0.90	0.01	0.03	4.4
2010LBVI_06M	1.45	0	0.03	2.1
2010LBVI_07M	0.64	0.02	0.20	34.4
2010LBVI_08M	0.83	0.13	0.40	63.9
2010LBVI_09M	0.61	0	0.02	3.3
2010LBVI_10M	0.59	0.10	0.38	81.4
2010LBVI_11M	1.57	0	0.13	8.3
2010LBVI_12M	1.06	0	0.18	17.0
2010LBVI_13M	1.65	0.14	0.23	22.4
2010LBVI_14M	1.76	0.27	0.05	18.2
2010LBVI_15M	1.37	0	0.10	7.3
2010LBVI_16M	0.58	0.01	0.20	36.2
2010LBVI_17M	0.88	0	0.35	39.8
2010LBVI_18M	1.17	0.16	0.04	17.1
2010LBVI_19M	0.74	0.06	0.29	47.3
2010LBVI_20M	1.84	0.03	0.20	12.5
2010LBVI_21M	1.65	0	0.27	16.4
2010LBVI_22M	1.07	0	0.17	15.9
2010LBVI_23M	1.16	0	0.15	12.9
2010LBVI_24M	0.37	0	0.03	8.1
2010LBVI_25M	0.45	0	0.03	6.7
2010LBVI_26M	1.68	0	0.04	2.4
2010LBVI_27M	1.35	0	0.01	0.7
2010LBVI_28M	1.53	0	0.33	21.6
2010LBVI_29M	1.65	0	0.31	18.8

2010LBVI_30M	1.56	0	0.16	10.3
2010LBVI_31M	1.42	0	0.01	0.7
2014 Territory Name	Amount of Riparian[2] Habitat in 1.9 acre (162-ft buffer) Territory	Amount of Riparian[2] Habitat Permanently Impacted within 1.9 acre Territory	Amount of Riparian[2] Habitat Temporarily Impacted within 1.9 acre Territory	% Territory Impacted[3]
2014LBVI_01M	1.19	0	0.06	5.0
2014LBVI_02M	1.14	0.01	0.02	2.6
2014LBVI_03M	1.37	0.01	0.03	2.9
2014LBVI_04M	0.31	0.02	0.19	67.7
2014LBVI_05M	0.69	0.12	0.33	65.2
2014LBVI_06M	0.56	0	0.12	21.4
2014LBVI_07M	1.18	0	0.24	20.3
2014LBVI_08M	1.14	0	0.12	10.5
2014LBVI_09M	0.87	0	0.17	19.5
2014LBVI_10M	0.85	0	0.14	16.5
2014LBVI_11M	1.31	0.16	0.07	17.6
2014LBVI_12M	1.58	0	0.09	5.7
2014LBVI_13M	1.78	0	0.20	11.2
2014LBVI_14M	1.69	0	0.13	7.7
2014LBVI_15M	0.91	0	0.39	42.9
2014LBVI_16M	1.12	0.13	0	11.6
2014LBVI_17M	0.66	0.06	0	9.0
2014LBVI_18M	1.21	0.03	0.26	24.0
2014LBVI_19M	1.84	0.03	0.20	12.5
2014LBVI_20M	1.32	0.13	0.25	28.8
2014LBVI_21M	1.20	0	0.27	22.5
2014LBVI_22M	1.42	0	0.28	19.7
2014LBVI_23M	1.71	0	0.33	19.3

1 No LBVI-occupied habitat is being permanently impacted from construction of the Project Action on DET Fallbrook.

2 The following riparian habitat layers were considered in the LBVI habitat analysis on MCBCP: mixed woodland, riparian forest, riparian woodland, southern riparian scrub, southern riparian woodland, southern sycamore-alder riparian woodland, southern willow scrub. For Detachment Fallbrook data, the "Riparian" habitat layers were used.

3 Percent of "Territory Impacted" includes both temporary and permanent impacts from construction of the Project Action.

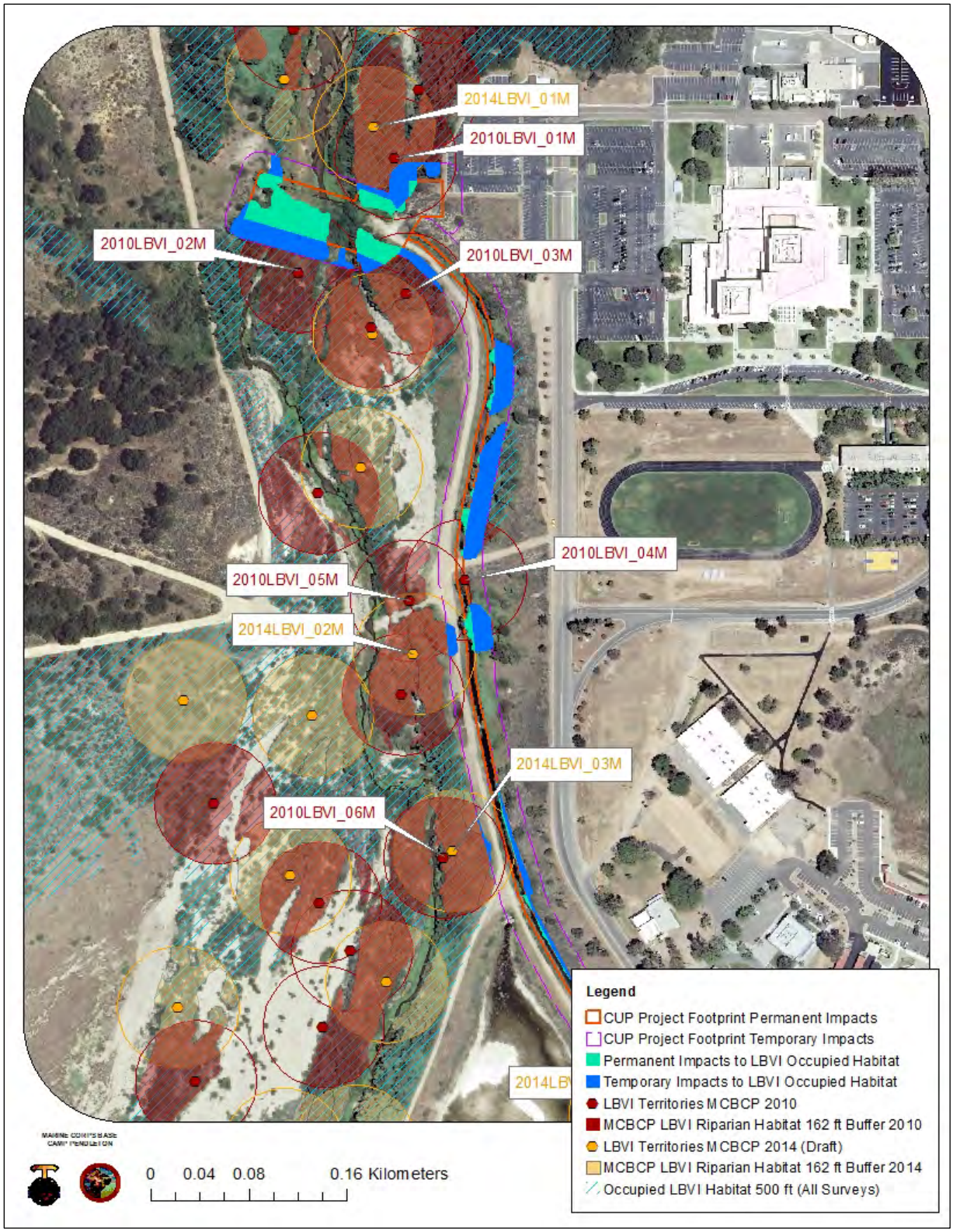

Figure C-6. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

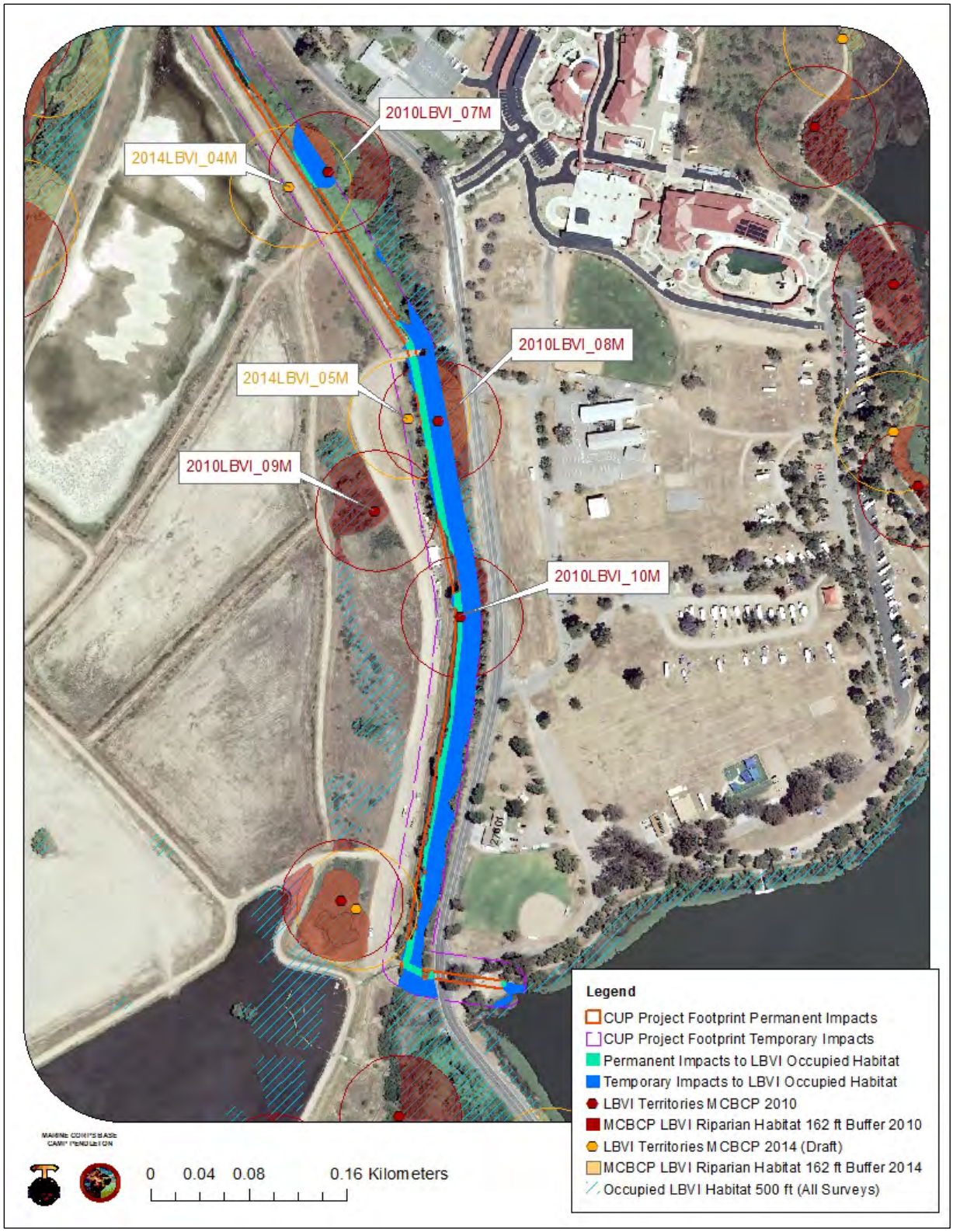

Figure C-7. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

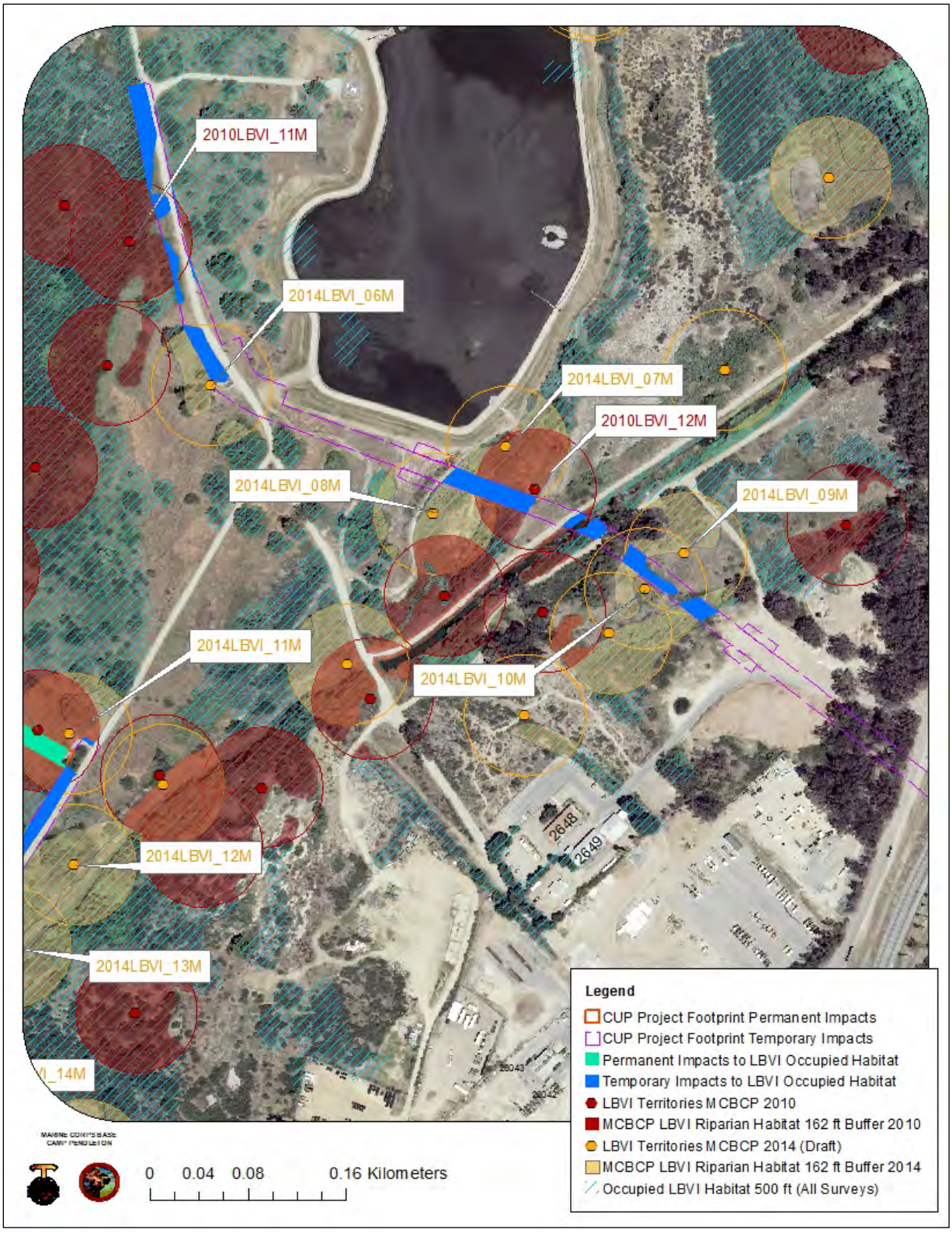

Figure C-8. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

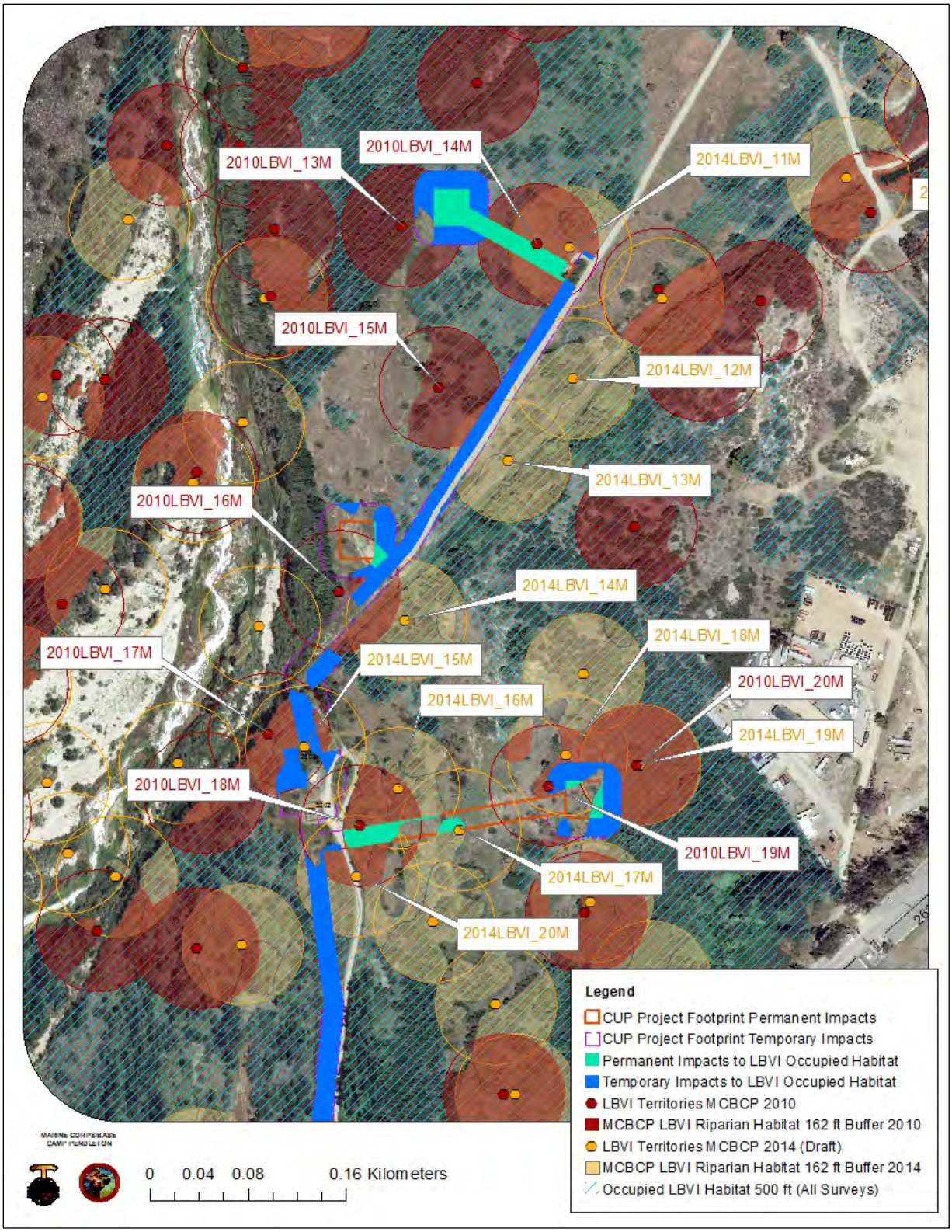

Figure C-9. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

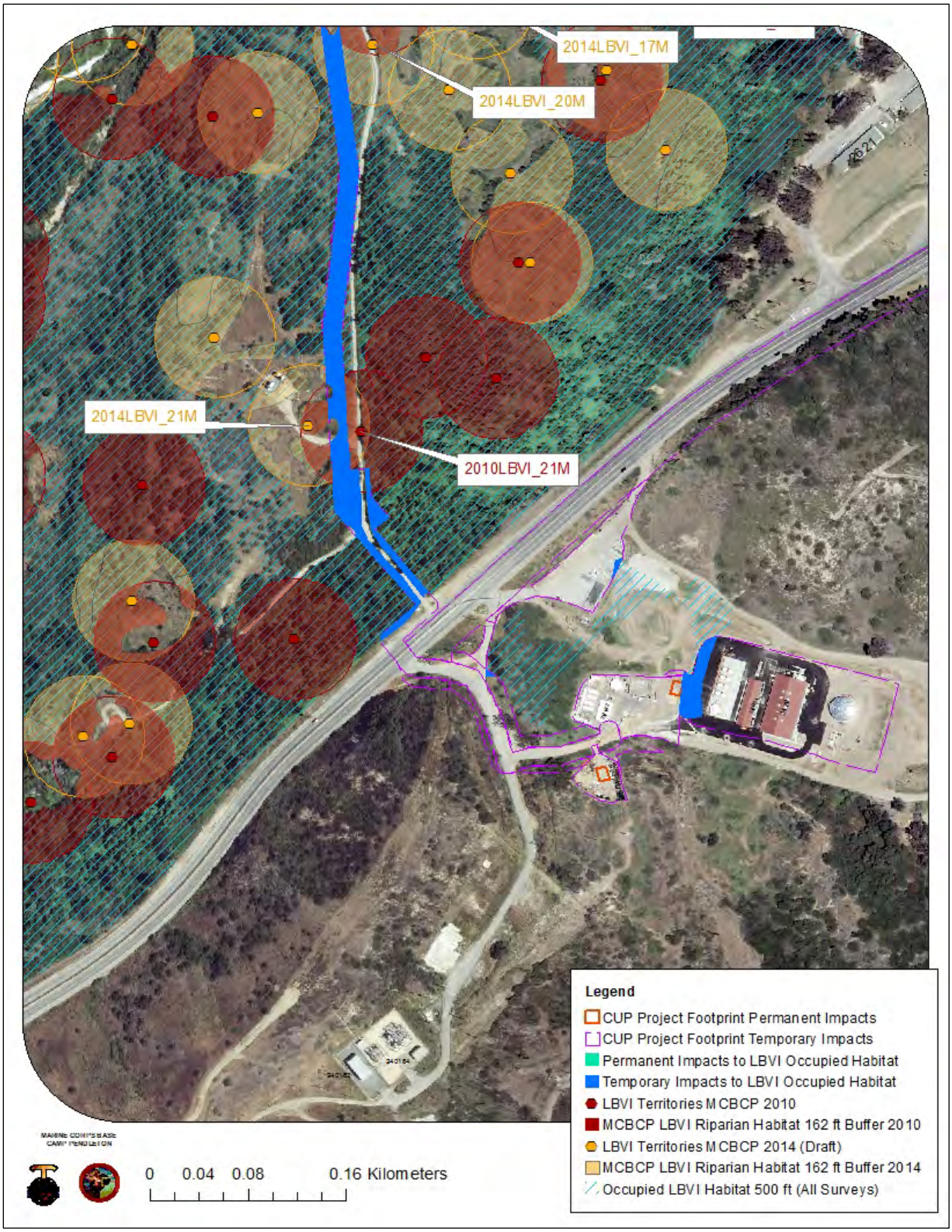

Figure C-10. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

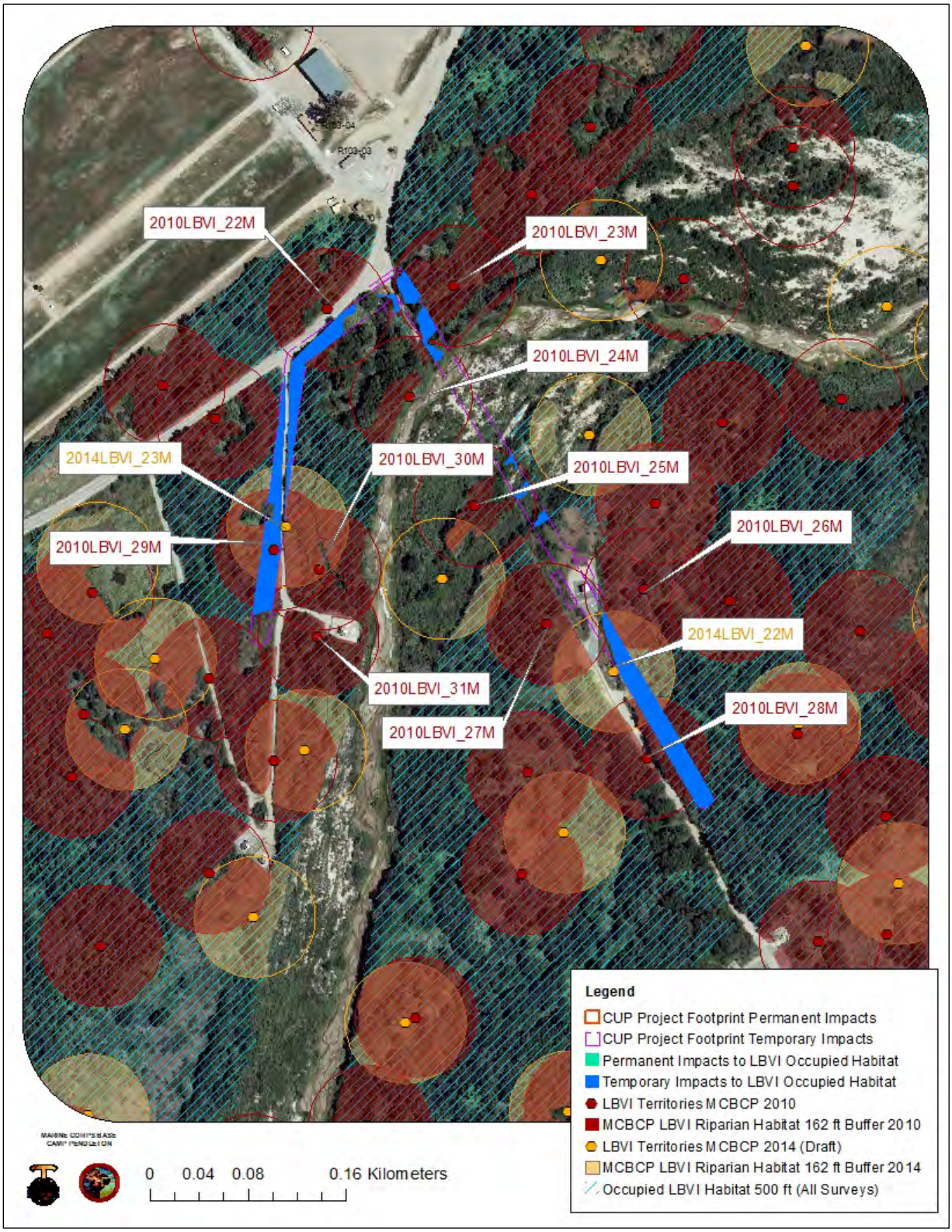

Figure C-11. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are directly impacted by construction of the Project Action.

Indirect Effects to Least Bell's Vireo (LBVI) Territories at the Diversion Weir

Construction at the diversion weir must take place during the LBVI breeding season; to determine how many LBVI may be significantly impacted by construction at the weir, the number of LBVI territories from 2010 and 2014 that overlap within 250 ft. of construction was noted (Figure C-12); 250 feet is the distance assumed where LBVI would be significantly impacted.

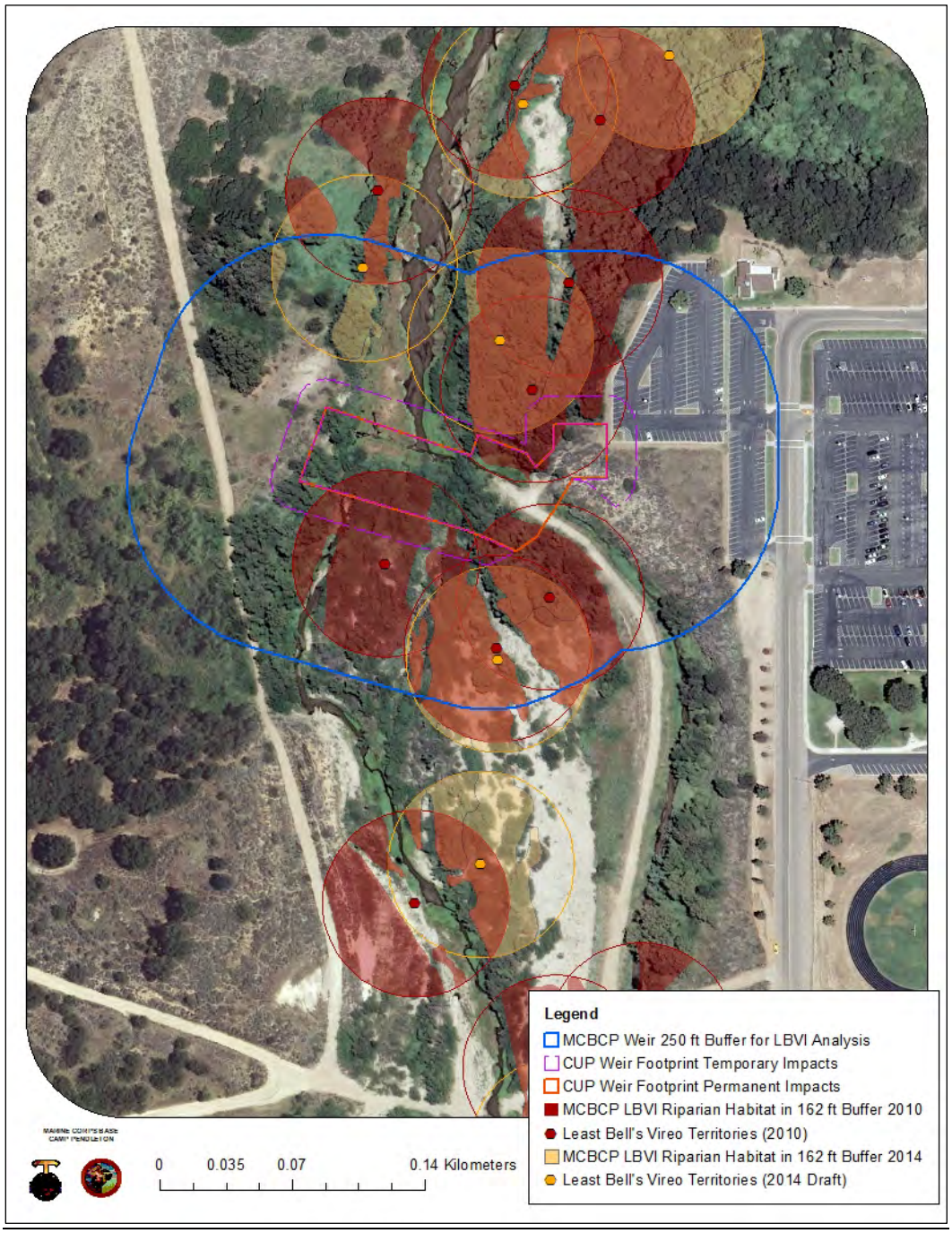

Figure C-12. MCB Camp Pendleton. LBVI Territories in 2010 and 2014 that are indirectly impacted by construction of the diversion weir.

California Gnatcatcher

With project construction, over 99% of the impacts to California gnatcatcher habitat are temporary. The amount of each 5.7-acre CAGN territory in 2009/2014 on DET Fallbrook and 2010/2014 on MCB Camp Pendleton that is temporarily impacted is noted in Table D-2. Territory names in Table C-7 correspond to those locations in Figures C-13 through C-15. A territory is considered significantly impacted if greater than 20% will be removed temporarily.

Table C-7.				
Percent Impact on CAGN Territories on Detachment Fallbrook				
2009 Territory Name	Amount of CSS in 5.7 acre (282-ft buffer) Territory	Amount of CSS Temporarily Impacted within 5.7 acres Territory	% Territory Temporarily Impacted	Burned in 2014?
2009CAGN_01	4.09	0.97	23.7	Partial
2009CAGN_02	5.26	0.65	12.2	Yes
2009CAGN_03	5.44	0.61	11.2	Yes
2009CAGN_04	5.70	0.01	0.1	Yes
2009CAGN_05	5.11	0.20	3.9	No
2009CAGN_06	5.56	0.22	4.0	No
2014 Territory Name				
2014CAGN_01	4.25	0.67	15.8	Partial
2014CAGN_02	5.22	0.32	6.1	Yes
Percent Impact on CAGN Territories on MCB Camp Pendleton[1]				
2014 Territory Name	Amount of CSS in 5.7 acre (282-ft buffer) Territory	Amount of CSS Temporarily Impacted within 5.7 acres Territory	% Territory Temporarily Impacted	Burned in 2014?
2014CAGN_01M	3.78	0.59	15.6	No
2014CAGN_02M	5.51	0.30	5.4	No
2014CAGN_03M	4.78	0.96	20.1	No

1 No CAGN Territories from 2010 are directly impacted from construction of the Project Action.

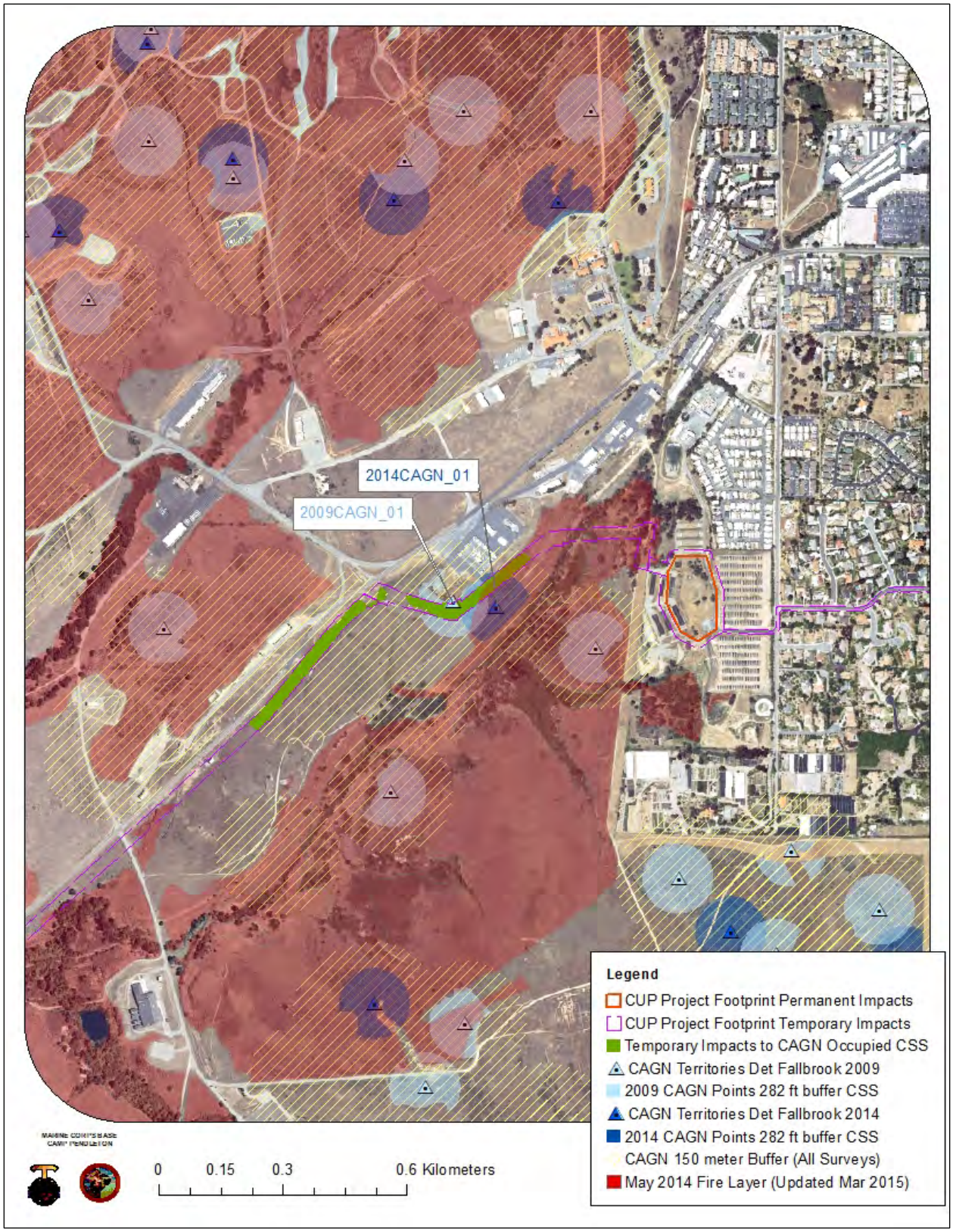

Figure C-13. Detachment Fallbrook. CAGN Territories in 2009 and 2014 that are directly impacted by construction of the Project Action.

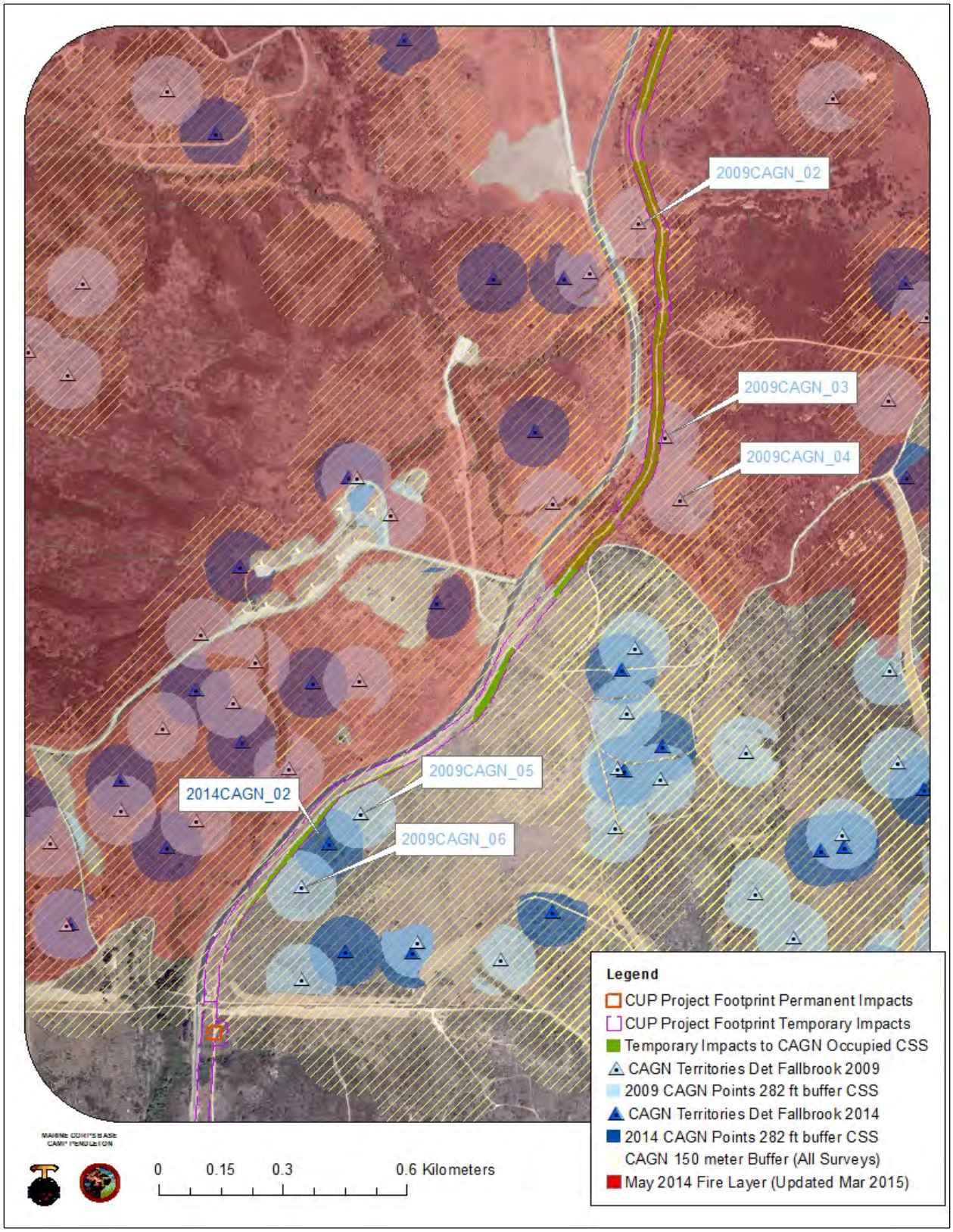

Figure C-14. Detachment Fallbrook. CAGN Territories in 2009 and 2014 that are directly impacted by construction of the Project Action.

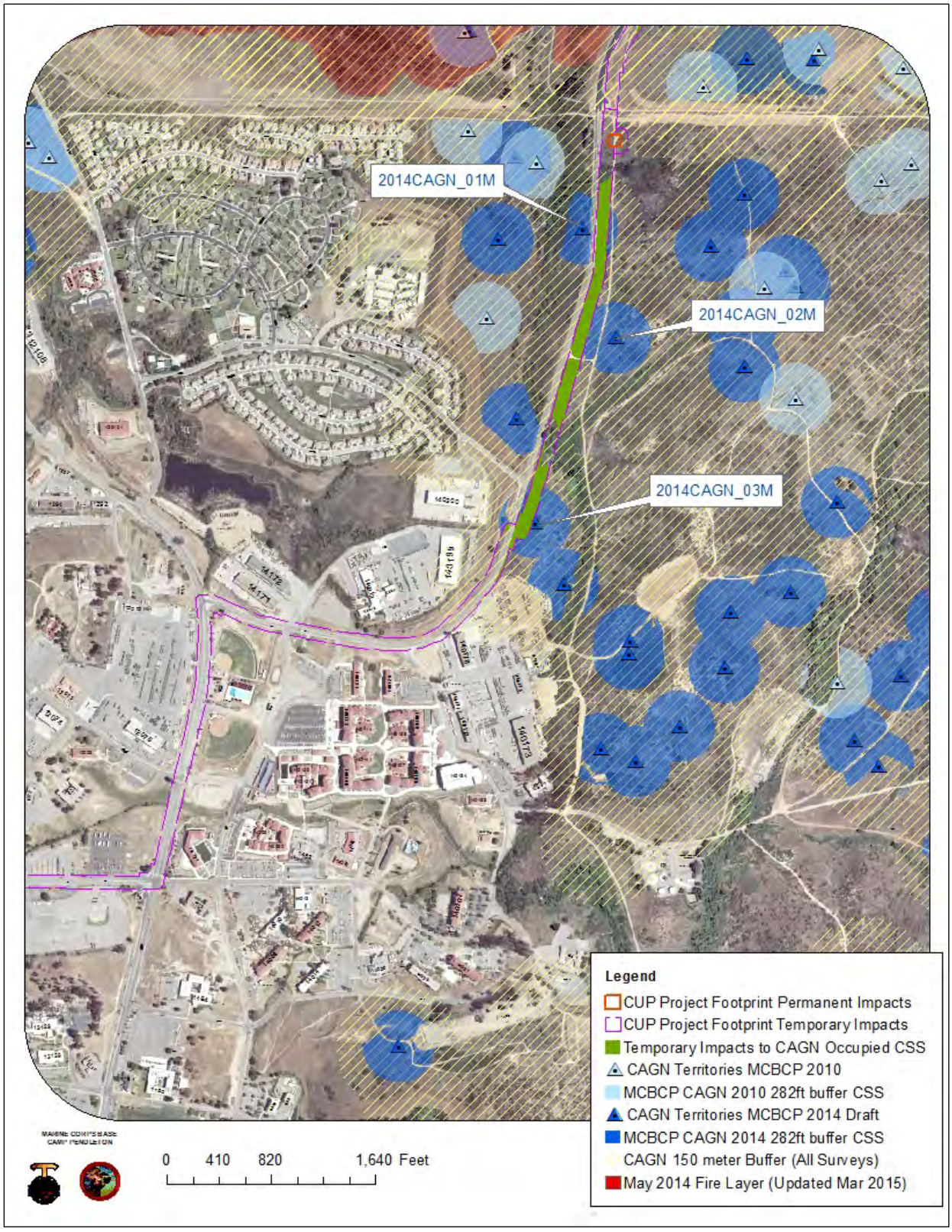

Figure C-15. MCB Camp Pendleton. CAGN Territories in 2014 that are directly impacted by construction of the Project Action. No 2010 CAGN Territories are directly impacted by construction.

Direct Effects to Stephens' Kangaroo Rat (SKR) Territories

With project construction, there is a total potential effect to approximately 1.29 acres of Stephens' kangaroo rat (SKR) occupied habitat; all effects are temporary from the construction of the Bi-directional Pipeline and located on Detachment Fallbrook.

A territory is considered significantly impacted if greater than 20% will be impacted. SKR surveying was conducted within the CUP project footprint, and within 300 feet from the footprint in appropriate habitat, in October and November 2015. Four locations of SKR were trapped during the Fall 2015 survey effort: one within the footprint, and three within the 300 ft. buffer (Table C-8; Figure C-16).

To estimate significant impacts, a 50-meter buffer was created around each positive SKR trap location during the 2015 effort. The 50-meter buffer represents an estimate of SKR "typical movements", where the individual typically moves short distances within its home territory. The MCB Camp Pendleton SKR Habitat Management Plan (in Draft in 2015; author: USGS) names that SKR typically move short distances (<50 meters). Note that two of the SKR territories (the trap location + 50 meter buffer) are located within the temporary CUP project footprint (Figure C-16).

The amount of non-developed habitat (all habitat types other than Ammunition Road, since this area was burned in the May 2014 wildfires thus creating more open habitat) within the 50-meter buffer for each of the positive SKR identifications was measured; the percentage of this habitat impacted by the CUP project footprint was calculated. In total, two of the four territories of SKR have significant impacts (Table C-8).

Table C-8.

Impact Analysis on Stephens' Kangaroo Rat Territories on Detachment Fallbrook[1]

SKR ID Number (2015 Territory Name)	Amount of Non-Developed Habitat[2] in 1.94 acre (50-meter buffer) Territory	Amount of Non-Developed Habitat[2] Temporarily Impacted within Territory 1.94 acre Territory (acres)	% Territory Impacted	Distance from CUP Temporary Impact Footprint (meters)
SKR2015_01	0	0	0	64
SKR2015_02	1.94	0.55	28.4%	16
SKR2015_03	1.68	0.74	44.0%	0 (within footprint)
SKR2015_04	0	0	0	59

1 No SKR-occupied habitat is being impacted from the CUP project footprint on MCB Camp Pendleton. On Det Fallbrook, all impacts are temporary with the construction of the Bi-directional Pipeline.

2 All habitat types other than Ammunition Road (developed) were considered for the SKR analysis. Habitat is predominately non-native grassland, and Diegan coastal sage scrub burned by the May 2014 fires.

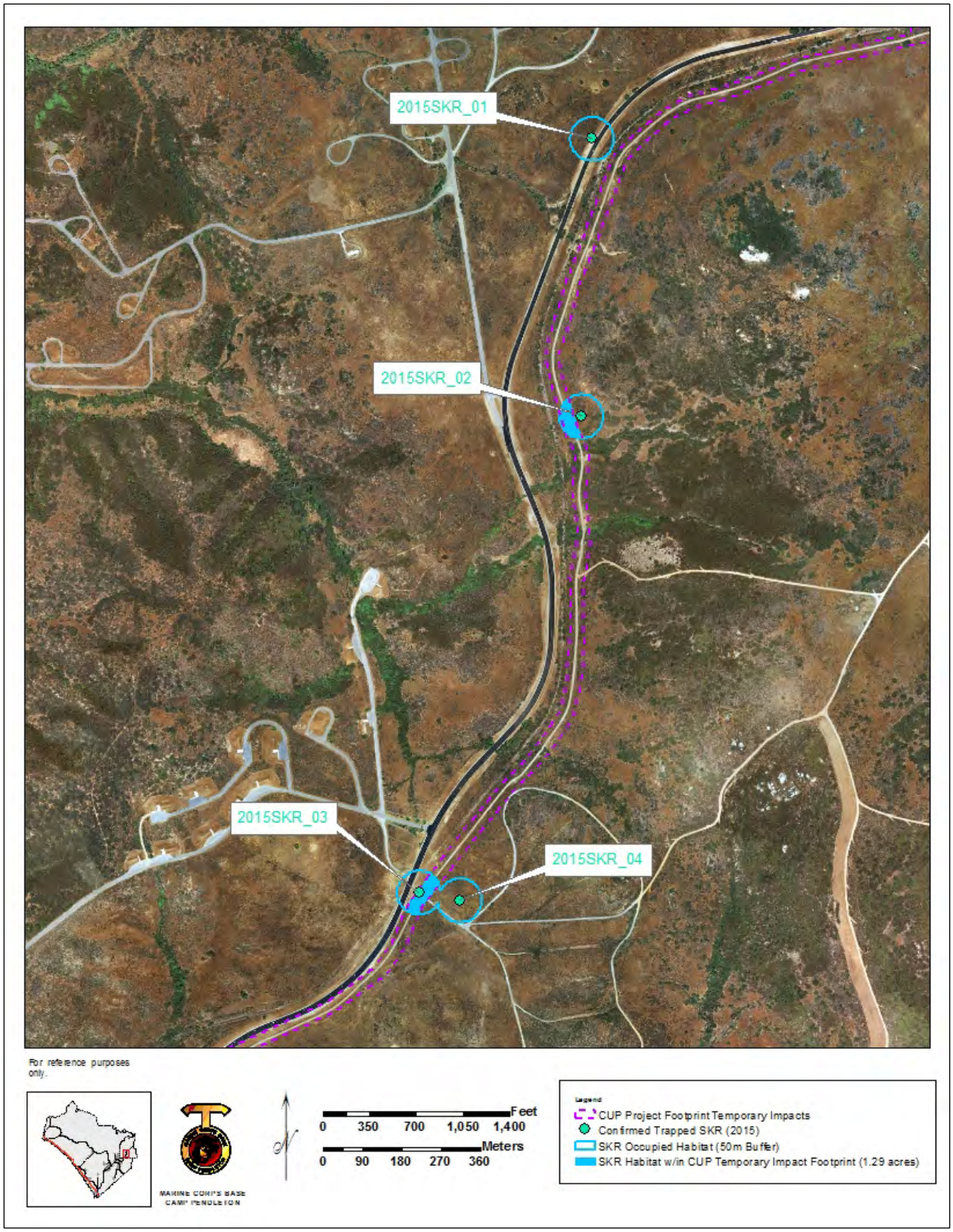

Figure C-16. Detachment Fallbrook. SKR Territories, as defined as 50 meters around positive trap locations during survey efforts in 2015, which are directly impacted by construction of the Project Action.

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Appendix C-6

Technical Memorandum: LSMR Groundwater Model

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TECHNICAL MEMORANDUM 102913.1

2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: mollyp@stetsonengineers.com

TO: AC/S Environmental Security DATE: October 30, 2013

FROM: Stetson Engineers Inc. JOB NO: 2408-1001

RE: Use of Groundwater Model to Estimate Impact to Riparian Vegetation from the Proposed Santa Margarita River Conjunctive Use Project and its Relationship to the Riparian Biological Opinion

Stetson Engineers was requested to assess potential impacts to Arroyo Toad habitat on the Santa Margarita River due to the proposed Santa Margarita River Conjunctive Use Project (CUP). Using the results from the Lower Santa Margarita River (LSMR) Groundwater Model, Stetson was able to assess changes in streamflow conditions between historical and future groundwater management operations. The model results that were relied upon to investigate segments of the river that were either flowing or not flowing were based on the model developed to assess the passage criteria for steelhead in the Lower Santa Margarita River (Stetson, 2012).

The LSMR Model for the CUP was developed using the United States Geological Survey (USGS) MODFLOW surface and groundwater finite difference model, to simulate groundwater flow in the Lower Santa Margarita Basin (Reclamation, 2007). This model was then adapted to investigate opportunities for steelhead passage in the Lower Santa Margarita River based on comparing historical to future CUP conditions. The period of record chosen to represent historical conditions was based on the hydrology and groundwater operations that occurred between Water Year 1997 and 2009. Using the same climatic conditions, the 13-year hydrology that occurred during the historical period was applied to represent future conditions. Hence, potential project related impacts on the environment could be assessed based on comparing historical to future results.

The results developed from the historical and future LSMR model runs were reviewed for specific months that corresponded to field data collected for Arroyo Toad. While the model does not assess conditions on specific species, it does estimate changes that occur to environments that the species rely on for survival. Specifically, the Lower Santa Margarita River is represented in the LSMR Model by 200-ft by 200-ft grid cells. The data from individual cells that underlie the river were reviewed and compared for flow/no flow conditions. The results of this analysis were provided under separate delivery to AC/S Environmental Security on October 29, 2013.

During the development of the LSMR Model, simulated water levels in riparian (Figure 1) and grassland indicator cells were reviewed in order to estimate the impact of groundwater

management operations (Reclamation, 2007). The location of both riparian and grassland cells were based on historical monitoring well data and locations where monitoring wells could be most useful to determine project related impacts. Riparian indicator cells were located outside the active river channel, but as close to the riparian corridor as to monitor variations in groundwater levels below the river. Grassland indicator cells were located away from the riparian corridor in areas where phreatophytes did not occur. Historical aerial photographs and vegetation GIS coverage maps, provided by AC/S ES, were used to distinguish between vegetation types that relied on groundwater and those that only relied on precipitation. These data were used as input to the LSMR Model so evapotranspiration (ET) by phreatophytes could be simulated.

During the development of the LSMR Model and the management scenarios developed for the CUP, three constraints were placed on the future project conditions: 1) aquifer compaction could not occur; 2) pumping could not cause seawater intrusion, and; 3) historical depth to groundwater could not be exceeded. In all management scenarios investigated and presented in development of the CUP, all three of these constraints were met.

The LSMR Model simulates evpotranspiration (ET) by phreatophytes based on depth to groundwater and the root zone. The equation that is used by the model to calculate ET is based on an inverse relationship between maximum potential ET and depth to groundwater; the greater the depth to groundwater the less ET will occur. At a point called the extinction depth, ET goes to zero since the roots are not able reach groundwater levels. The LSMR Model uses an extinction depth of 20 feet below ground surface for trees, 8 feet for wetland areas, and 3 feet below ground surface for water.

The relationship between the riparian indicator cells, the depth to groundwater beneath the river, and the extinction depth of phreatophytes was not directly studied prior to our investigation of Arroyo Toad. Because of the restrictions of the Riparian Biological Opinion to maintain groundwater levels within 15 feet of riparian vegetation, Stetson Engineers began an investigation of the relationship between model constraints and simulated groundwater levels. While the riparian indicator cells were previously chosen to represent water levels below the river, they were not located within riparian vegetation due to restrictions in well construction activities that would occur in these areas. Hence, the existing monitoring wells, located in riparian indicator cells, were used to link model generated water levels to historical minima.

Review of LSMR simulated groundwater levels below the active stream channel showed that CUP related water levels were within 15 feet of the ground surface in both the Upper Ysidora and Lower Ysidora Sub-basins (Figure 2a and 2c). Inspection of the groundwater levels below the active river channel in the Chappo showed that the simulated values were within 15 feet in 39 of the 50-year simulated period based on 1952 to 2001 hydrology (Figure 2b). During 10 of the 11 years that were characterized by groundwater levels greater than 15 feet below the simulated riverbed surface during future CUP conditions, the CUP simulated levels were higher

than baseline conditions. Both baseline (historical) and future CUP conditions were simulated using the same 50-year hydrologic period of record that occurred between 1952 and 2001.

The LSMR model results describe a reduction of 100 AFY (4%) in ET by phreatophytes from the Baseline to the CUP model runs, while meeting all three model constraints. The same model results also show that observed historical minima in riparian indicator cells, which may be located outside the riparian corridor, are met during the same 50-year simulation period. Finally, recent review of the model results, related to Arroyo Toad analysis, indicate that the groundwater levels below the river bed are within 15 feet in the Upper and Lower Ysidora Sub-basins; and higher than Baseline groundwater levels in the Chappo Sub-basin.

Based on the LSMR Model results, a potential exists for a reduction in phreatophyte ET during CUP conditions that will require monitoring under the Adaptive Management Program/Facilities Operation Plan (AMP/FOP). A simulated reduction in phreatophyte ET could be expressed in the field as stressed vegetation or an actual loss of vegetation. The goal of the AMP/FOP will be to tie the LSMR simulated results to the actual field observations and subsequently adjust the pumping schedule to avoid adverse impacts. The AMP/FOP will incorporate the relationship between the riparian indicator cells and the health of the riparian vegetation so that the requirements of the Riparian Biological Opinion are met. Additionally, the results from the on-going Arroyo Toad monitoring program will be used as an input to the AMP/FOP so that observed pools and streamflow are used in the decision making process.

MODFLOW STREAMFLOW CONSTRAINTS RELATED TO THE ARROYO TOAD ANALYSIS

The MODFLOW streamflow routing (SFR) package[1] was used to simulate flow in the main Santa Margarita River channel; and to account for diversions to the recharge ponds and Lake O'Neill, spills and releases from Lake O'Neill, and side tributary flows to the main channel within the model domain. The SFR used 284 model cells to represent the main river channel[2] from upstream of the diversion structure to the Lower Ysidora Narrows.

The SFR tracks flow in the stream cells and water exchanges with the groundwater aquifer. Leakage from the stream to the aquifer is calculated for each cell based on the head difference between the aquifer and the stream, and on the streambed conductance term. The amount of leakage at each stream cell (either into or out of the aquifer) is integrated into the groundwater flow model water budget[3]. Streambed recharge to the aquifer ceases when all of

[1] USGS Open-File Report 88-729; Documentation of a Computer Program to Simulate Stream-Aquifer Relations using a MODFLOW. USGS Open-File Report 2004-1042; A New Streamflow-Routing (SFR1) Package to Simulate Stream-Aquifer Interaction with MODFLOW-2000.

[2] The SFR package for the LSMR Model simulated a total of 673 stream cells to account for the diversion channel, the Lake O'Neill outlet channel, Fallbrook Creek 'bypass', 20 side tributary drainages, historical oxidation pond discharge locations, and the MCAS channelized drainage ditch. During dryer months, many of the drainages had do flow; however during wet years, all of the stream cells simulated streamflow.

[3] *ibid,* USGS Open-File Report 88-729

the streamflow in the upstream reaches has leaked into the aquifer resulting in a dry stream. Sometimes, if the groundwater level in the aquifer is above the streambed elevation, base flow from the aquifer to the stream can occur and the river can have a flowing reach downstream of a dry reach[4].

For the Arroyo Toad analysis, flow in the model cells that represent the Santa Margarita River main channel was processed from the model output files. The available simulated streamflow in the model cells includes: flow into the model cell, flow to or from the aquifer, and flow out of the model cell[5]. If the simulated stream is dry, there is no recorded flow. A post-processing spreadsheet was developed to extract the flow data for each stress period (month) of interest. GIS files were constructed to provide mapping for the extents of flow and no-flow cells.

There are constraints that should be considered in order to develop a thorough understanding of what can be inferred from the modeling efforts. The following components of model construction can influence the streamflow results:

- The streamflow calculations are highly dependent upon the streambed elevation assigned to each stream cell. Stream bed elevations were based upon TOMI/TOMA[6] five-foot contour intervals and USGS topographical maps. Smoothing was required so that the streambed progressed down gradient. A fraction of a foot difference between the assigned elevation and the 'true' elevation could affect the flow/no-flow result.
- The streambed conductance (leakance in and out of the aquifer) term is constant throughout the simulation period.
- Model cell size was constructed with 200-foot by 200-foot cells. The stream cell width was kept constant with the model cell size. More stream cells were used at wider portions of the river. Each monthly stress period simulates the river as the same size, whether it is dry, normal, or wet. This can affect the available flow available for recharging the aquifer and in the stream.
- Average monthly flow is simulated into the upstream model cell. This does not account for the flashiness of the stream system following flood events. The model results are from the end of the monthly stress period when streamflow is often different from average flow.

There are constraints that should be considered to develop an understanding of what can be inferred from the model. Foremost of these constraints is the sensitivity of both ground elevation and groundwater level surfaces. Variations in these surfaces of few inches may cause a cell to be depicted as either flowing or not flowing. Variations of these surfaces of a few feet

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[4] Some simplifying assumptions occur with the SFR package: streamflow entering the modeled area is assumed to be instantly available to downstream reaches during each monthly stress period. This assumption generally holds true given the relative difference between the slower groundwater flow compared to the faster surface water flow. Another assumption is that leakage between streams and aquifers is instantaneous[4]. In other words, the stream leakage to the aquifer is limited only by the head difference and the streambed conductance term, and will fill any unsaturated cells beneath the stream as if flows downstream until it are dry.

[5] Fortran print flags were added to the SFR package to have the streamflow printed to the flow model's output file.

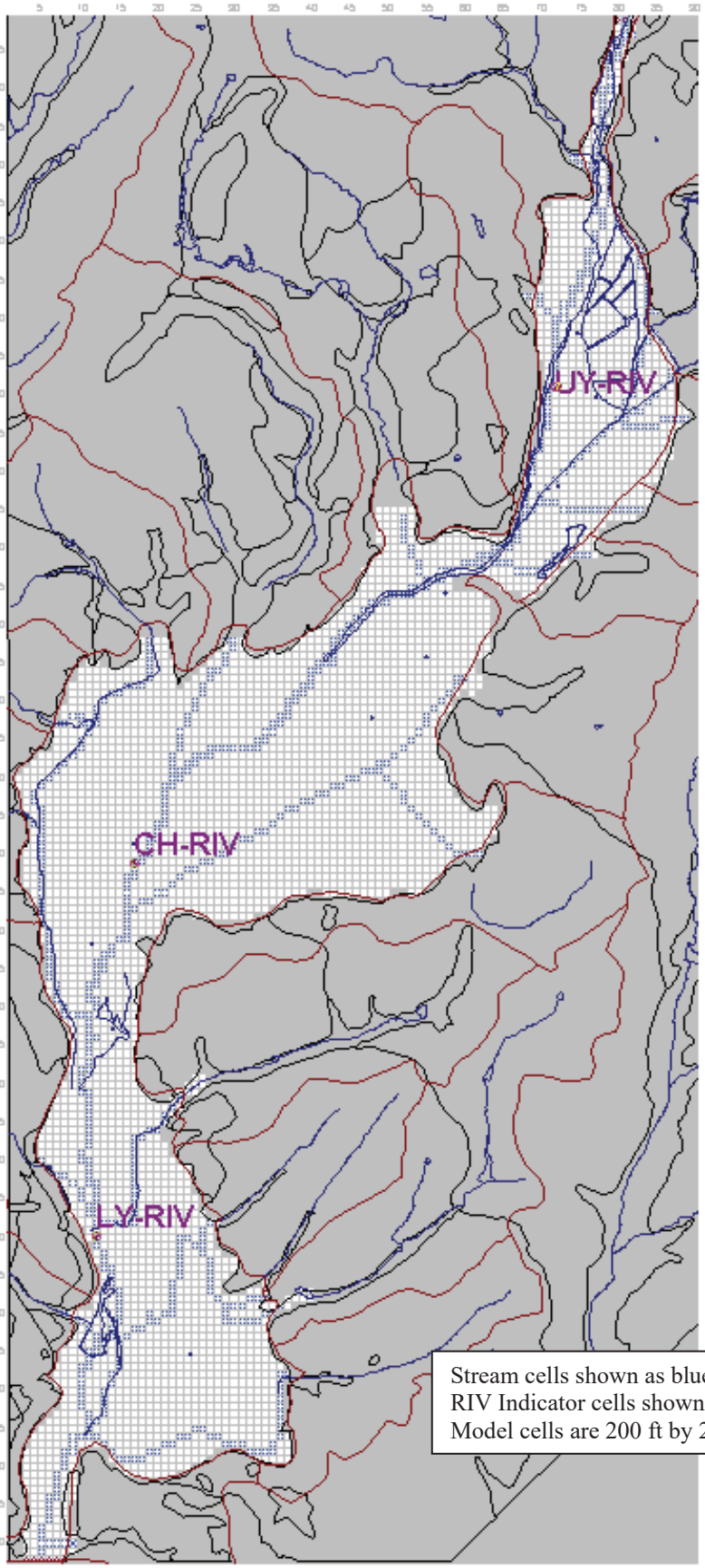
[6] Army Corps of Engineers, 2001; Topographical minima and maxima (TOMI/TOMA) 5-foot contour intervals.

may result in entire reaches (multiple contiguous cells) being shown as flowing or not flowing. Representations of average monthly groundwater pumping and average monthly groundwater levels may represent actual conditions during one part of a month, but not during other parts of the same month. Based on the constraints associated with the accuracy of surface elevations (both ground and water level), empirical data that relate observed streamflow data to monthly stresses, at locations other than Basilone Bridge (USGS #11046000), will be required to refine the results of the Arroyo Toad analysis as it relates to project related impacts to streamflow.

REFERENCES

Department of the Interior, Bureau of Reclamation (Reclamation). 2007. Santa Margarita River Conjunctive Use Project: Final Technical Memorandum No. 2.2, 2 Volumes. Prepared by Stetson Engineers Inc. April 2007.

Stetson. 2012. Southern California Steelhead Passage Assessment, Lower Santa Margarita River, California and CUP Surface Water Availability Analysis (TM 1.1). Prepared for U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Marine Corps Base Camp Pendleton, and Fallbrook Public Utility. 27 April.



STETSON ENGINEERS INC.

Arroyo Toad Study

LSMR Model Location Map Showing River Indicator Cells

FIGURE 2A Run 16b & Baseline Hydrographs
2-Party Negotiation Model Run; 10,800 Average Annual AFY

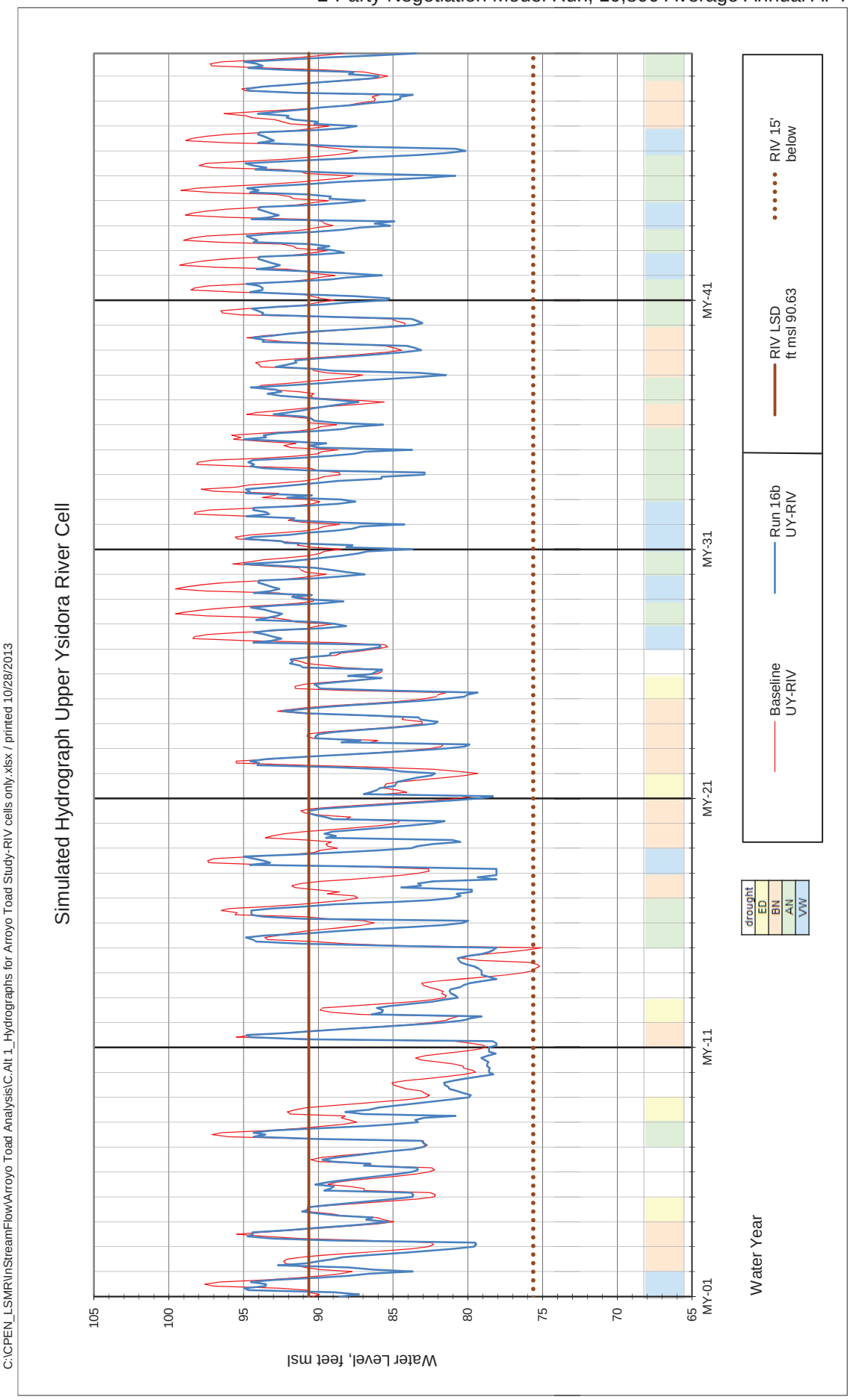


FIGURE 2B Run 16b & Baseline Hydrographs
2-Party Negotiation Model Run; 10,800 Average Annual AFY

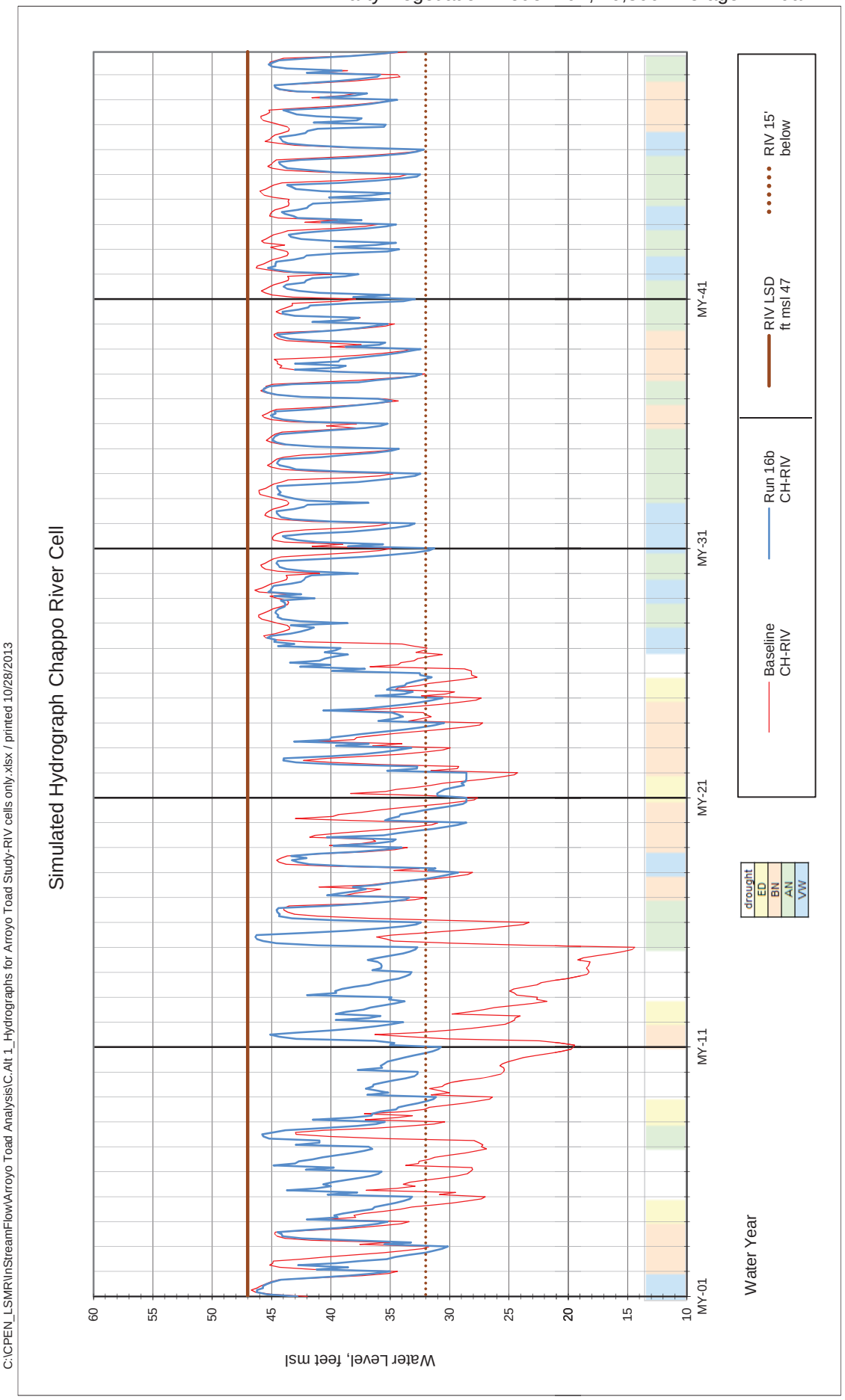
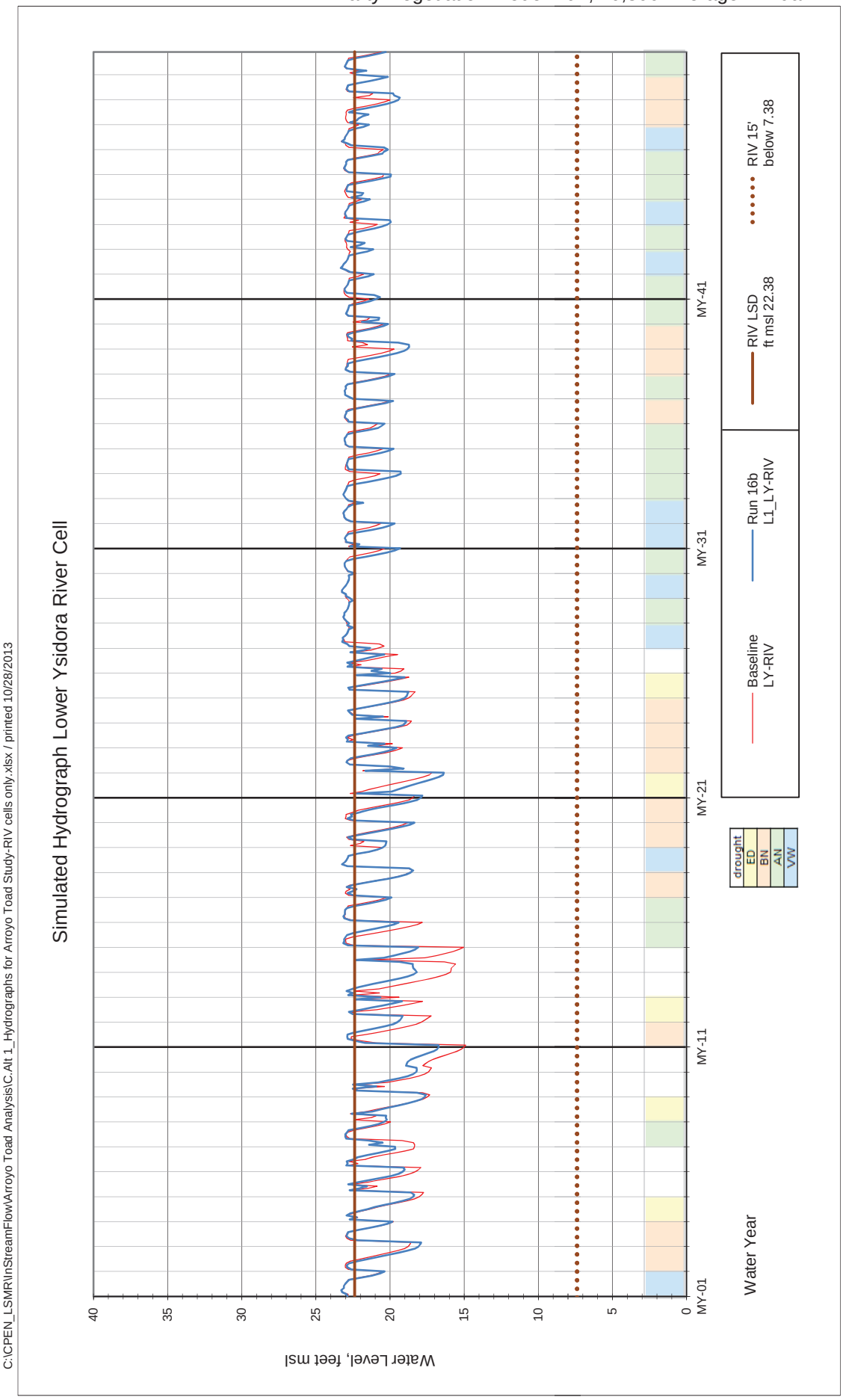


FIGURE 2C Run 16b & Baseline Hydrographs
2-Party Negotiation Model Run; 10,800 Average Annual AFY



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Appendix C-7

Technical Memorandum: Operational ARTO Impacts

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FROM: MCB Camp Pendleton, Environmental Security
TO: U.S. Fish and Wildlife Service
DATE: January 28, 2016

SUBJ: OPERATIONAL IMPACTS TO SEGMENTS 4 THROUGH 8

The purpose of this enclosure is to respond to the United States Fish and Wildlife Service (USFWS) request to look at Conjunctive Use Project (CUP) water management operational impacts to Segments 4 through 7[1] on the lower Santa Margarita River (SMR) and provide a conservation measure for operations on these reaches for the Section 7 USFWS consultation. The September 2015 BA provided an impact analysis for the entire basin downstream of the Point of Diversion that was performed following consultation with USFWS, USGS Biological, USGS Hydrological, and Camp Pendleton personnel (See Attachment 1). Following review of the September 2015 Biological Assessment (BA), a request was made by the USFWS to investigate impact to water resources in Segments 4 through 7 due to the critical nature of these reaches to support ARTO habitat.

The original Lower Santa Margarita River (LSMR) Model presented in the September 2015 BA provides a robust impact analysis for the entire basin downstream of the Point of Diversion; however, statistically, it cannot be narrowed down to look at individual Segments (i.e., the sample size of modelled cells would be too small if individual Segments are evaluated). Therefore, the Lower Santa Margarita River (LSMR) Model was refined that increased the predictive accuracy by relying on observed hydrological and biological datasets. In order to establish accountability and provide a physical relationship between historical and CUP operational data in the future, the investigative area was expanded to include Segment 8 which contains the long-term USGS stream gauge at Ysidora (11046000).

This Attachment briefly describes the refined analysis for ARTO Segments 4 through 8 and the potential impact to these segments due to the CUP water management operations. The use of all available observed data to increase the accuracy of the updated analysis provides increased reliance in the use of the LSMR Model's simulated results. The results from the 10-year model were correlated with the 50-year model to assess the impact at Segments 4 to 8 during the balanced hydrologic period, showing a 14.6% impact. Impacts occur during Below Normal and some Above Normal Hydrologic conditions due to a shift in the occurrence interval.

[1] Segments 4-7 refer to transect segments designated by United States Geological Survey (USGS) arroyo toad monitoring plan, and shown to correspond to the arroyo toad population downstream of the Ysidora USGS gauge.

Assumptions of Existing Basin-wide Analysis

The September 2015 BA indicated that under Recent Management conditions, 59.7% of the stream within the model boundary is wetted for four continuous months over a 50-year period. Under CUP operations (named "CUP RPM-7 50-year" model in Table 1), the portion of wetted stream within the model boundary drops 11.6% to 48.1%, over the same 50-year period.

The value of this analysis is based on the statistical methods that relied on large amounts of data output from the CUP groundwater model to assess changes. The stream is represented by 220 cells, each of which has groundwater levels within the cell calculated 600 times over a 50-year period. In all, 11,000 values were used to statically analyze the impact of the CUP on the streamflow conditions in the Santa Margarita River. Therefore, the large population of points provide meaningful statistics when establishing the presence or absence of surface water over a large area (ARTO Segments 2 through 11).

The statistical analysis was further based on each cell requiring four months of continuous flow: March through June for (Very Dry) and Below Normal (BN); and April through July for Above Normal (AN) and Very Wet (VW)[2]. If four continuous months have groundwater levels less than 3 feet below the surface, then the cell is considered wet; if any one, or more, of the cells has depth to groundwater greater than 3 feet, then the cell is dry. The four month period for each hydrologic condition was based on data that extended beyond Segments 4 through 8; hence no allowance was made for early rainfall and storm events that might result in an above normal year with flows that naturally stopped before the end of June in Segment 6, but not in Segment 10.

The limitations of the groundwater model and meaningfulness of the statistical methods were previously established based on consultation with USGS-Hydro, USGS-ARTO, FWS, CPEN, and Stetson Engineers. In addition, the following points regarding the physical and environmental conditions should be considered when assessing available tools to assess impacts.

- The development of the 3-foot depth to water trigger, used to identify flowing cells throughout the entire stream reach, was based on the entire model dataset. The depth to water trigger for Reaches 4 through 7 would likely be a different value if only those data were to be assessed.
- Cell size in the model is 0.92 acres. A single cell may be simulating multiple elevations of the river from the thalweg to the 100-year flood plain.
- The river simulated in the model is static and is based on its 1968 location from a USGS topographic quadrangle. The actual river is an active channel, meandering back and forth across the floodplain, eroding and depositing sediments based on storm events.

In addition to these model constraints, as well as physical and environmental conditions, uncertainties exist regarding ARTO habitat, specifically:

[2] Annotation for hydrologic periods defined in the hydrologic model used in the USFWS CUP BA: VD- Very Dry; BN- Below Normal; AN- Above Normal, and VW- Very Wet.

- No direct relationship exists between groundwater levels and soil moisture used by ARTO for burrowing. CPEN installed soil moisture meters in 2014 and 2015, and have not yet gathered adequate data to develop a relationship.
- Uncertainty exists as to the "four continuous month" requirement for which the analysis is based. The analysis in the BA is based on March through June during Above Normal and Very Wet Years and April through July during Below Normal and Very Dry years.

The constraints and limitations of the model suggested the best method for assessing impacts to Segments 4 through 8 was to rely on observed data collected by the USGS ARTO and USGS HYDRO. The following section describes the development of a 10-year model for assessing impacts on Segments 4 through 8 by relying on observed data.

Methodology to Assess Impacts to Segments 4 Through 8

A new model run was simulated from 2005 to 2014 in order to assess its accuracy based on observed data gathered by both USGS ARTO and USGS HYDRO. Comparison of model results to actual field observations increases the reliability of the model to make predictive assessments of future CUP operations. The matrix provided in Table 1 depicts the streamflow, groundwater production, and infrastructure that was included in the development of the 10-Year LSRM Model Run. Comparison of the different Operational Parameters for the different model simulations show that 2005-14 Observed conditions were wetter than the 50-year period; and groundwater pumping was less than that which would occur under future CUP conditions.

Two model runs were simulated using the 10-year LSMR Model: (1) Observed Conditions ("Observed 2005-2014"); and (2) CUP conditions ("CUP RPM-7 2005-2014"). The Observed model run simulated actual streamflow and groundwater pumping that occurred between 2005 and 2014. The CUP model run simulated future stresses that would occur under project conditions. Both simulations provided information on the occurrence of surface water in the stream channel and groundwater levels below the channel on a cell by cell basis. Each of these cells can then be associated with ARTO Segments so that simulated data can be compared to actual field observations by both location and time.

Surface flow and groundwater level output data from the 10-Year LSMR Observed Model Simulation was sorted by stream segment so it could be compared to USGS Flow at Ysidora and USGS ARTO observation of flow at specific segments. The result was a time based matrix from 2005 through 2014 that compared: location, USGS ARTO estimated flow, USGS Flow at Ysidora, simulated depth to groundwater, and simulated presence of surface water.

The results of comparing these datasets indicated that simulated depth to groundwater in Segments 4 through 8 did not offer the best degree of accuracy in determining presence of water when comparing to the USGS ARTO estimated flow at specific cells. Further investigation determined that if both simulated depth to water and presence of surface water was compared to USGS ARTO observed flow,

then the accuracy of simulating historical occurrences of surface water increased. Hence, a simulated cell was determined to have water present if either the depth to water was less than 3 feet or surface water was flowing in the stream cell.

The 10-Year LSMR Model was then used to simulate future CUP conditions over the same period from 2005 to 2014 so that it could be compared to the historical simulation. Similar to the verification process of simulated historical conditions to observed conditions, the simulated presence of water was based on either the depth to water being less than 3 feet or the occurrence of surface water in the stream cell. Observed simulated data was compared to CUP simulated data for Segments 4 through 7 as shown in Figure 1. A similar graph showing a comparison of the Observed model run to the CUP model run, for Segments 4 through 8, showed that there was no impact since flow occurs continuously under both conditions at Segment 8 (Ysidora Gauge).

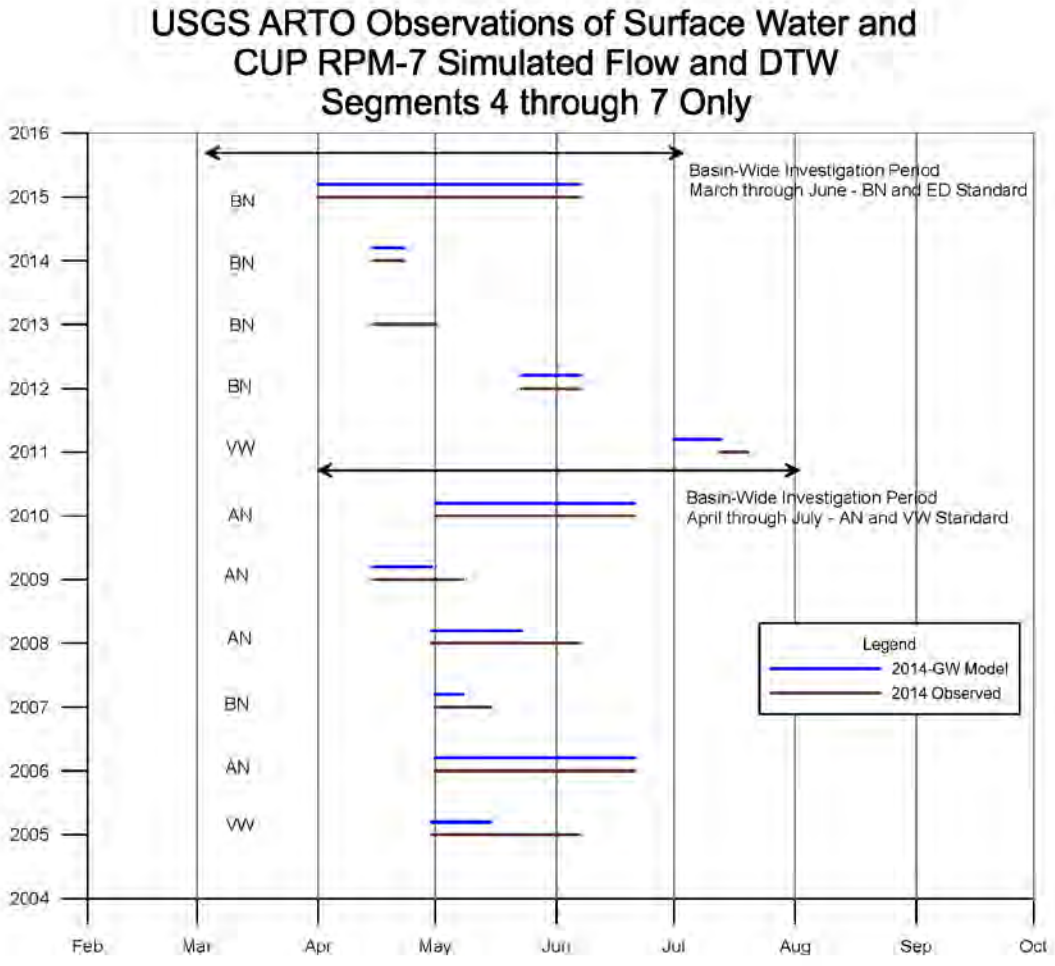

Figure 1

CUP impact in Figure 1 is shown by the difference between the blue line (CUP) and brown line (observed). The plot only reflects the observations made by USGS ARTO when surface water was present and does not identify data points when the stream was dry. The results of this analysis showed that observed observations collected by USGS indicate ARTO are finished breeding in July of Very Wet years; June of Above Normal years; and May of Below Normal years. The observed and modeled data also show that when flow was present in any of these three months, it was present in the preceding months as well. Therefore, there is no need to look at continuous data, only at the data that indicates whether surface water was present at the end of the ARTO breeding cycle, based on hydrologic condition.

Qualitative analysis during model verification (comparing simulated with observed data) indicated impacts occurred during at the following segments under differing hydrologic conditions.

- Segment 4 – 2007 BN
- Segment 5 – 2007 BN and 2009 AN
- Segment 6 – 2007 BN
- Segment 7 – 2013 BN
- Segment 8 - none
- Impacts occur during Below Normal and some Above Normal Hydrologic conditions due to a shift in the occurrence interval.
- Very Wet (2005 and 2012) and Extremely Dry (2013 and 2014) conditions not affected.

Impacts to ARTO Habitat in Segments 4 through 8

Based on the model verification for Segments 4 through 8 discussed in the previous section, an impact analysis was performed using the 154 model stream cells that align with Segments 4 through 8. The following assumptions were used to assess future CUP impacts:

- 10-year model developed (Observed and CUP Simulations)
- Actual USGS ARTO and Ysidora Flow data used to validate relationship between observed data (flow) and report presence of water (ARTO) in Segment 4 through 8.
- Analysis relied on DTW greater than 3 feet or presence of surface flow
- Presence of water in July to analyze VW
- Presence of water in June used to analyze AN

– Presence of water in May used to analyze BN and VD/ED

The simulated streamflow and depth to water for the Observed and CUP Model were compared for each of the ARTO stream segments 4 through 8 for the presence of water based on hydrologic condition (i.e., the last month during VW is July, June for AN, and May for BN or VDED). The Observed model run simulated the presence of water at the end of the last month based on hydrologic conditions 90.7% of the time. The results from the Observed 10-year model (2005-2014) were correlated with the 50-year model to assess the impact at Segments 4 to 8 during the balanced hydrologic period; the model run simulated the presence of water 76.1% of the time, with the CUP water management operations showing a 14.6% impact in Segments 4-8 (Table 1). Hence, the impact to Segment 4 through 8 are greater than the averaged simulated impacts along the full length of the Santa Margarita River below the Point of Diversion, which are 11.6%.

Table 1. Observed and CUP 10-Year LSMR Model Runs to Assess Impacts to ARTO Segments 4 - 8

Run / Operational Parameter		1	2	3
	units	Observed 2005-2014	CUP RPM-7 2005-2014	CUP RPM-7 50-year
STREAMFLOW AND RECHARGE				
WY2005-2014 Observed Hydrology w CWRMA	AFY	46,160	46,160	38,300
GROUNDWATER PRODUCTION				
Historical Groundwater Pumping	AFY	6,050		
Future CPEN Demand	AFY		7,820	7,820
Conjunctive Use Project Yield	AFY		10,710	10,710
INFRASTRUCTURE				
Historical/Existing Infrastructure		✓		
CUP Diversion Structure, Ponds, Wells			✓	✓
Bypass Flows – Riparian / Steelhead	cfs	3	150/60/3	150/60/3
RIPARIAN 10-YEAR IMPACT ANALYSIS FOR USGS BIOL SEGMENTS 4-8				
WY 1952-2001 (50-Year Model) 10-yr Model Results Projected to 50-Year Model for USGSbiol Segments 4 - 8	%	*n/a*	14.6 %	*n/a*
RIPARIAN 50-YEAR IMPACT ANALYSIS				
Full Stream USGS Segments 1 - 11	%	*n/a*	*n/a*	11.6 %

APPENDIX

DESCRIPTION OF MODEL RUNS

Historical Model Run: The Historical model run includes conditions with less streamflow prior to CWRMA releases, historical groundwater production for camp supply and agriculture use, and the existing diversion structure with historical Lake O'Neill and recharge pond operations. The Historical model run also includes an average annual wastewater release of 1,400 AFY that either recharged at the oxidation ponds or discharged to the stream; this was discontinued in the early 2000s. This Historical model run simulates the changes in Base's water demand, agricultural land use, infrastructure, and management practices from WY 1952 through WY 2001.

Recent Management Model Run: The Recent Management model run incorporates the current operation of production wells and infrastructure using the 12-year period from WY 2003 through WY 2014. CWRMA releases with the existing Lake O'Neill and recharge ponds are simulated under Recent Management conditions. This model run was established to evaluate the hydrologic conditions over a 50-year balanced model period with continued management practices and the Base's water demand that exists today.

The simulated surface water and groundwater conditions for each model run are described below and used to assess impacts in Chapter 5 and 6. The Historical model run simulates actual conditions that occurred between 1952 and 2001, while the Recent model run simulates conditions that would have existed during the same 50 years if CWRMA, pumping, and other recent water management operations were in effect. Both model runs are useful for assessing impacts in the future under project conditions since they may provide a range in what may occur due to variability in well location, pumping volumes, and other water management techniques that change over time.

CUP RPM-7 Model Run (50-year): The CUP model run includes CWRMA releases and improvements in infrastructure to the diversion weir, headgate and ditch, ponds, and Lake O'Neill. The groundwater production meets both the Base's future water demand and the water delivery requirement to FPUD. This model run included an AMP that satisfied the riparian groundwater level constraint during dry conditions. Improvements to the diversion weir, headgate, and ditch result in an increase in diversion capacity from 60 cfs to 200 cfs. Recharge ponds 6 and 7, which were not previously operational, have been rehabilitated for use under the CUP to increase recharge capacity in the Upper Ysidora Sub-basin. Other improvements include additional wells to allow CPEN to pump additional groundwater during Very Wet hydrologic conditions to meet the water delivery requirements to FPUD so pumping may be curtailed during drier conditions to reduce the impact on the environment. Additionally, from consultation with the National Marine Fisheries Service (NMFS), diversion operations were modified to maximize opportunities for upstream and downstream migration of steelhead, and to preserve the natural shape of the receding limb of the storm hydrograph. The net result is a modification of diversion timing and rate, and a reduction of project yield from the original CUP model presented in the September 2015 BA.

Observed 2005-2014 Model Run: Observation-based analysis utilizes USGS ARTO data from 2005 to 2014, observed streamflow at the Ysidora (USGS) gauge, and Model Simulations to predict the presence of water in these segments. Additional model run (not a new model) that added a new parameter-observed data, modified from the existing basin-wide surface and groundwater model (LSMR).
The use of observed data by the USGS (ARTO and HYDRO) allows for validation of the 10-year model

and the ability to measure impacts under Project conditions through the AMP.
Validated against 20 transects within 4 segments. Model matched observed data in nearly all cases (99%). Stream-aquifer interaction investigation (on-going) was relied upon to tie Segments 4 through 7 to flow at the Ysidora Gauge (Segment 8). USGS ARTO data show a correlation exists between streamflow at Ysidora and flow at downstream segments.